Advancing the study of food discourses through human ecology

by

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Submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

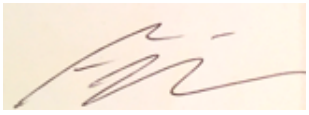
of the Australian National University

April 2019

Australian National University

Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.



Federico Dávila Cisneros Date: April 22 2019

Acknowledgements

This thesis was made possible through the support of my supervisors, institutional colleagues, Philippine colleagues and rural smallholder farmers willingness to participate, friends, and family. The biggest thanks go to Associate Professor Lorrae van Kerkhoff, who has been a mentor, colleague, inspiration, and friend throughout my candidature. Lorrae's supportive nature and continuous questioning of my thinking has enabled me to produce a research output I am proud of. David Dumaresq supported the philosophical and agricultural dimensions of my work, and provided continued critical debate and structural logic to the thesis. Dr Tira Foran allowed me to deeply question my data, assumptions, analytical tools, and writing style, and opened a new way of interpreting my material. All three supervisors provided me with intellectual and personal support, enabling me to advance my research and critical thinking capabilities. Financially, this doctorate was supported by an Australia Postgraduate Research Scholarship.

Colleagues from the Fenner School of Environment and Society were sensationally supportive and critical throughout my time there as a doctoral candidate, tutor, and occasional lecturer, and researcher. A special thanks goes to Dr Robert Dyball, whom I travelled to the Philippines many times with to solidify our local partners and build joint research and pedagogical opportunities. Our long drives and beer sessions together in the Philippines, Canada, the Snowy Mountains, and Luxembourg helped us develop a shared vision of food systems research and teaching, which I hope we advance in the future. The academic staff including Steve Dovers, Saul Cunningham, Xuemei Bai, Jannette Lindsay, Jamie Pittock, Mark Howden, Steve Crimp, Claudia Muñera Roldan, Peter Ramshaw all supported the ongoing development of ideas throughout this work and the turbid process of a doctoral project. My PhD colleagues, Carl, Edwina, Catherine, Claudia, Monique, Nicole, David, Alex, Katie, Hannah, Ayako, Rick, Megan, and Kelly, all provided time for laugher and a range of other emotions during the PhD process. My new kind and critical sustainability colleagues at the Institute for Sustainable Futures, University of Technology Sydney, supported me in the final stretch, and opened me to new ways of thinking which I will take forward in my scholarly work. Ngaire Kinnear provided very useful editorial support for the unpublished chapters.

My Philippine colleagues enabled the ideas to develop with contextual legitimacy, and access to local research and knowledge allowed me to work closely with smallholder communities and local research centre. Jennifer Amparo was a sensational friend and research colleague. Jenny, thank you for opening friendships and professional doors, and it was a pleasure conducting our PhDs together in a Philippines context. Carla, Sue, Emi, Carisma, Dino, Dean Raden, and the College of Human Ecology, the Philippines SEARCA provided invaluable networks and intellectual input, allowing me to pursue research that was salient to the research needs of the Philippines. The Philippine farmers who I interviewed confirmed how research can improve human and environmental systems throughout the world. Their knowledge and experiences are critical if we are to advance food systems towards more ethical and just environmental and social domains.

A network of friends supported my ideas, writing, and thinking about food security and systems thinking. A special thank you to Emily Dillon, who read numerous drafts and encouraged me to pursue both academic and non-academic enquiry into food systems. Tom Sloan, who I have had the pleasure of writing and working with over the last six years in an academic and professional capacity, provided friendship and constructive reading and editing, particularly towards the end of the thesis. Jo and Jake provided a critical eye from Europe and excellent map creation assistance, and my aunt Maria de Lourdes Cisneros provided assistance with visuals.

My family provided fun, relaxation, and reality check to the purpose of doing a PhD. Despite our geographical distances, the love and support were never lost. Our family's value and encouragement towards education has shaped my own beliefs and approaches to teaching and learning. Ian and Lesley also always provided interest and support during the process, and Lesley provided highly useful editorial advice on a number of manuscripts. Ian and Lesley also allowed us to spend time in Canberra during the difficult writing years, making the writing journey a lot more homely and relaxing.

Finally, to Steph. We have gone through the wonderful, and sometimes complex and frustrating, world of doing two PhDs together in different but related sustainability fields. We encouraged and motivated each other in every step of the way, and I am proud of what we have achieved together. Our decision to advance our research and practice in sustainability, and spend a few years writing out of our wonderful coast house, is something I will take with me forever.

Preface

Here I present a series of paper that combined make up my thesis by compilation. Each paper has either been published, submitted or is in preparation for peer reviewed journal at the time of submission of this thesis. While the papers are linked and presents different analysis and theoretical developments that make up my full thesis, each was written as a stand-alone manuscript for submission in academic books or journals. As such, there is unavoidable repetition in some chapters relating to the context and methods used.

The format and structure of this thesis comply with the Australian National University's guidelines for "Thesis by Compilation". The thesis begins with an extensive Context Statement that situates the literature and research topic within a body of work. A methodological foundation for the thesis is in Chapter 2. Chapters 3-4 present literature and theoretical developments, while chapters 4-7 present empirical analysis of different field work in the Philippines. Chapter 8 concludes the thesis and the major contributions to knowledge in the thesis. Editing of different manuscripts, published and unpublished, has been restricted to matters covered in Standards D and E or the Australian Standards for Editing Practice.

I carried out the majority of the work presented in the papers for this thesis. This includes the question formulation, literature analysis, qualitative design, coding structure, finding study sites, building relationships, and disseminating outputs.

All photos taken by myself in the Philippines.

Paper I: Davila, F. and Dyball, R., 2018. 'Food Systems and Human Ecology: An Overview. In Koenig, A. (ed) *Sustainability Science: Key issues*, Routledge, London, pp. 183-210.

Contributions: FD designed the review, read and analysed literature, and wrote the manuscript. RD assisted in analysis and editing.

Paper II: Davila, F., 2018. Human ecology and food systems: Insights from the Philippines, *Human Ecology Review,* 24(1): 23-50, Available at: http://doi.org/10.22459/HER.24.01.2018.02

Contributions: FD designed the review, read literature, wrote full manuscript.

Paper III: Davila, F. Dyball, R. Amparo, J.M. 2018. Transdisciplinary research for food and nutrition security: Examining research-policy understandings in Southeast Asia. *Environmental Development.* 28, 67-82.

Contributions: FD designed the study, collected data, analysed data, and wrote the manuscript. RD collected data and assisted with design and editing. JMA collected data and assisted with design and editing.

Paper IV: **Davila, F.** (Revision submitted). Human ecology and food discourses in a smallholder agricultural system in Leyte, the Philippines. *Agriculture and Human Values.*

Contributions: FD designed the study, collected and analysed data, wrote the manuscript.

Paper V: Davila, F. Dumaresq, D. (in prep). Cleaning the land and intercropping: Environmental adaptation and co-existing food discourses among Philippines farmers. *Journal of Rural Studies.*

Contributions: FD designed the study, collected and analysed data, wrote the manuscript. DD assisted in analysis and editing.

Abstract

Achieving food and nutrition security is a major sustainable development challenge. Multiple actors make food decisions that influence social, economic, and environmental systems. These decisions are made to meet multiple goals related to food, ranging from production practices to waste management strategies. To comprehensively understand how the outcome of food and nutrition security can be achieved, the conceptualisation of food systems has become common in sustainability-oriented research. Food systems research seeks to understand how human and environmental drivers influence food and nutrition security outcomes. Quantitative indicators and models exist that can predict how systems might behave under different biophysical circumstances. However, there is a recognised need to create a better understanding of how human behaviour influence food systems. Human ecology offers a systems-based approach for revealing on the role of discourses and their influence on institutional responses to food challenges.

In this thesis, I develop human ecology as a methodology to show how two dominant food discourses, food security and food sovereignty, are embedded in food systems literature and smallholder agriculture in Southeast Asia and the Philippines. The ongoing tensions between both discourses in research and policy and growing interest on social science approaches to food systems makes this contribution relevant to both researchers and practitioners.

My first contribution is theoretical, made up of two published papers. The first manuscript explores human ecology as an analytical framework to study food systems literature. The second paper applies the same framework to Philippines food policy history to contextualise the current state of their food system. From these papers, I show that the human ecology framework adds value to food systems research by highlighting the influence food discourses have on framing approaches to food activities.

My second contribution is empirical, documenting the application of human ecology thinking to two sets of qualitative data. The first data set is a systems workshop held in June 2015 in Los Baños, the Philippines, with policy and research experts from Cambodia, Laos, Thailand, and the Philippines. These stakeholders are expected to conduct transdisciplinary food systems research in their countries with support from regional research agencies. The second data set is made of up 39 semi-structured interviews with smallholder coconut farmers from Leyte, in the Philippines. The Philippines has over 100 million people, half of whom are based in rural areas and have poor food and nutrition security outcomes. The strong dominance of cash commodity production policies, growing need to adapt to climate change, and the unique biodiversity context of the Philippines makes food systems research essential for sustainable development.

I found that market food security discourse dominates policy and research, perpetuating current institutional behaviours and framings of smallholders as passive agents in agricultural systems. I also found that smallholders hold a strong discourse of market solutions to food security, which drives them to pursue cash commodity production to improve their incomes. In parallel, smallholders

also hold a discourse focused on diversification strategies, such as agroforestry and farmer-led solutions, as ways out of hunger and poverty. These themes align with ideas within the food sovereignty discourse; however this discourse continues to operate on the periphery and cannot be acted on given the dominance of market food security in guiding food system interventions.

I conclude the thesis my highlighting the contributions of my theoretical and empirical findings to knowledge on Philippine studies, sustainable development, food systems research and human ecology.

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Chapter 1: Context Statement

Food systems are made up of interactions between human and environmental drivers on food activities, ranging from production to waste management, ultimately resulting in food and nutrition security (Ericksen, 2008a). A series of quantitative indicators and models exist to show the relationship between human and environmental drivers influencing food activities. These include, for example, the positive and negative outcomes associated with greenhouse gas emissions, (Campbell *et al.*, 2017; Vermeulen *et al.*, 2012), socio-economics of agricultural activities (Dethier and Effenberger, 2012), biodiversity loss (Chaudhary and Kastner, 2016; Fischer *et al.*, 2017), malnutrition and obesity (Fanzo, 2014; Gustafson *et al.*, 2016), exceeding environmental thresholds (Springmann *et al.*, 2018), and food waste management (Foley *et al.*, 2013; Parfitt *et al.*, 2010). Qualitatively, the critical social sciences have contributed detailed analysis of history, politics, economics, social justice, and philosophical issues through a broad food systems lens (Bernstein, 2016; Lövbrand *et al.*, 2015). These critical social science studies have grown to document how social relations influence food activities and food system outcomes across different contexts and scales (Delaney *et al.*, 2018; Hospes and Brons, 2016). The outcome of the different parts of a food system is ultimately achieving food and nutrition security (Ericksen, 2008a; Ingram, 2011a). This objective is commonly defined by the Food and Agriculture Organisation (FAO) as

> "…a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2018p. 177).

Wider outcomes from interacting food system activities include environmental change, such as land clearing and greenhouse gas emissions, profit for producers and corporations, health outcomes for society, food waste, and worker wellbeing, among many others (IPES Food, 2017; Lawrence *et al.*, 2010).

Social studies of food and nutrition security have identified how social inequalities, problem framing, and stakeholder perceptions influence food system activities (Candel, 2014; Clapp, 2015; Galt, 2013; Lövbrand *et al.*, 2015; Pereira and Drimie, 2016; Pereira and Ruysenaar, 2012; Rivera-Ferre, 2012). There have also been studies into how global institutions, such as the FAO, World Trade Organization (WTO), and global development agendas such as the Millennium Development Goals and Sustainable Development Goals embody different perspectives on the processes that influence food and nutrition security outcomes at different scales (Clapp, 2014a; Clapp, 2017; Clapp and Murphy, 2013; Lee, 2013; Wilson, 2013). The social sciences offer tools and frameworks capable of identifying the drivers and motivations behind food sustainability, critically advancing the interdisciplinary nature of food problems (Rivera-Ferre, 2012; Thompson and Scoones, 2009).

Institutions play an important role in food systems (Shaw, 2009). The term 'institutions', as used throughout this thesis, refers to the underlying rules and structures (formal or informal) that influence the social, economic, and political transactions in social systems (Dovers, 2005; Fischer

et al., 2012). Critical social sciences studies are able to explore competing perspectives within food systems, and examine how different discourses are influenced by and have influence over specific contexts and institutions. Discourses are core human ideas, developed through experience and action, that influence how social systems interact with their environments (Dryzek, 1997; Hajer and Versteeg, 2005). Consequently, discourses can be regarded as fundamental expressions of the social structures that shape human choices, beliefs and actions. The links between human discourses and food systems can help food systems researchers and practitioners identify, document and ultimately intervene in addressing the underlying root drivers of how people and institutions respond to food challenges (Leventon and Laudan, 2017). Discourses are also critical to the framing and interventions in food systems, as the study of discourse is concerned with issues of power between individuals and groups (Hay, 2008). Understanding power and unequal relations are core to achieving sustainable food systems, as there is a range of power asymmetries between food producers, consumers, policy makers, and businesses. The work of critical political economists and sociologists has identified how food has become largely corporatised, with a handful of private enterprises controlling agrochemical inputs and seeds for major food crops (Carolan, 2016; Clapp, 2017; McMichael, 2009a; McMichael, 2014). Studies focusing on smallholders and landscapes have also identified how the rapid expansion of industrial crops have jeopardised social equity and wellbeing, and created new power structures within rural settings both in advanced and emerging economies (Cramb *et al.*, 2016; Dressler *et al.*, 2016a; Dressler *et al.*, 2016b; Hall, 2015; Li, 2014). Given how power is woven throughout all food system activities, it is critical to understand how core discourses are perceived and acted on by food actors.

This thesis advances the study of food discourses within the growing field of food systems research. I advance this through developing a conceptual framework that connects a systems-based human ecology approach with discourse analysis, and applying it to literature, workshop activities, and a case study of smallholder coconut farmers in the Philippines. Through my analysis, I examine some of the feedback processes between dominant food discourses and institutional responses across different scales. I focus on smallholder approaches to agriculture, and how discourses are embedded in agricultural practices and policies in the Philippines. Agricultural activities in the Philippines remain a major source of rural livelihoods (UNDP, 2013), yet are faced with systemic challenges identified within a food systems framework, notably environmental change and a long history of socio-political relations set up through colonial legacies. Human ecology, as the guiding theory used throughout this thesis, supports the analysis of how two dominant food discourses – market food security and food sovereignty – are embedded in food systems literature and among policy makers, researchers, and smallholder farmers in the Philippines and Southeast Asia. The thesis presents a set of findings on the relational nature of food discourses, and the challenges and opportunities for advancing food systems research in Southeast Asia in light of their current policy and research agendas.

Human ecology, as a field of study, is driven by the explicit critique of reductionist methodologies that reduce complex problems into objectively measurable but isolated entities, limiting the researcher's ability to contextualise such observations in the broader cultural and historical processes that have influenced particular systems (Dyball, 2010; Dyball, 2017; Rambo, 1983). Human ecology provides a methodological structure for looking at complex sustainability problems in detail while acknowledging the broader social and environmental processes that influence the system (Dyball, 2010; Dyball and Newell, 2015; Marten, 1986; Polk and Bruckmeier, 2005; Rambo, 1983). The explicit concern for going beyond describing the state of systems, and identifying how different human-held discourses influence the systems behaviour, makes human ecology a suitable tool for analysing the paradigmatic root causes of sustainability challenges (Abson *et al.*, 2017). With a strong history of integrated social-biophysical enquiry, recent developments in human ecological scholarship have linked the abstract nature of human ecology with a normative systems-dynamics-based framework that enables the analysis of how systems *ought* to operate to be sustainable in the future (Dyball and Newell, 2015). Examining the behaviour of systems in specific contexts helps us understand how deeply embedded discourses develop as environmental and social processes change. Such analysis helps researchers use case-specific knowledge that can offer lessons to take to other case studies, ultimately advancing knowledge for sustainable development (Adler *et al.*, 2018; Magliocca *et al.*, 2018; Newell and Siri, 2016). I describe human ecology as a methodology in Chapter 2, and define the analytical framework that is used to capture the underlying discourses and associated feedbacks of these on institutions, human wellbeing, and ecosystems. I further develop human ecology with food and nutrition security issues in the literature and in the thesis case study of the Philippines (Chapters 3 and 4). In Chapters 5, 6 and 7, I apply similar analysis to qualitative data from a workshop with food and nutrition security experts from Cambodia, Laos, Thailand, and The Philippines, and semi-structured interviews with smallholder farmers from Leyte, the Philippines. In Chapter 8, I synthesise the major theoretical and empirical contributions of the thesis and show I have advanced the study of human ecology and food systems.

The combination of theoretical and empirical research in this thesis provides an example of how human ecological enquiry is useful for studying the social drivers in food systems, with a particular focus on the linkages between discourses and institutional arrangements. The theory and methods in this research seek to enable future food system professionals and researchers to critically examine the underlying discourses and their relationships to institutionally-embedded rules and norms that lead to particular stakeholders behaving in particular ways. Such analysis can help identify possible points of intervention in the food systems activities that stakeholders perceive can lead to improving their immediate food and nutrition security. I use semi-structured interview data from 39 smallholder farmers in Leyte, the Philippines; workshop outputs from systems mapping activities with 18 Southeast Asian researchers and policy makers; and theoretical literature analysis to show how this human ecology perspective can be used to capture the prevalence of food discourses in different contexts. I also demonstrate how smallholder farmers in a specific food

system frame alternative discourses, and the institutional barriers to breaking out of the food production discourse embedded in the Philippines. I present the theoretical and empirical materials across five manuscripts prepared for publication in academic journals or books (Chapters 3-7), and present an additional methodological chapter (Chapter 2) and a synthesis chapter (Chapter 8). At the time of thesis submission, three manuscripts are published (Chapters 3–5), one has been revised after reviewer feedback (Chapter 6), and one is in preparation for submission (Chapter 7).

This introductory chapter presents the major concepts from different disciplines that frame the design of this thesis, introduces the case study of the Philippines, and presents the main research questions and contributions of the thesis. The core ideas that influence my methodological approach are highlighted in this chapter in the form of 'orienting concepts', as per Layder's adaptive theory (1998). These are concepts that are embedded in the researcher's way of framing the nature of a particular problem, and hence informed the core questions in this research. I start by highlighting the sustainability challenge of feeding a growing population without exceeding planetary boundaries, while simultaneously improving human wellbeing. I then contextualise the history of food systems thinking, and how it enables linking environmental change and socio-political disciplines. I introduce the concept of food discourses and their relevance to existing food systems literature. I argue that looking at the established literature debates between market-oriented food security, and social equity and agricultural diversification-oriented food sovereignty, presents an opportunity to advance the study of institutional responses to discourses in food systems. I then use the conceptual foundations of the thesis to introduce the context of food systems research in Southeast Asia, with a specific focus in the Philippines. I conclude the chapter with an overview of how the research questions are answered, the major thesis contributions, and transition to Chapter 2 to introduce my epistemological stance and choice of conceptual framework.

1.1 Thesis research questions

The overarching research question guiding this study was:

To what extent does applying a human ecology framework help capture links between food discourses and institutional behaviours in food systems?

To answer this question, I apply a systems-based human ecology framework to relevant literature and case study data from one systems workshop and 39 semi-structured interviews with Filipino smallholder farmers. The sub-questions for this study were:

- How does the human ecology framework help guide literature analysis of food system discourses?
- What discourses exist among policy and research groups responsible for food and nutrition security activities?
- What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?

- How do these theoretical and empirical findings contribute to advancing food systems and human ecology scholarship?

1.2 An adaptive approach to research

This study followed a specific conceptual framework – the human ecology Cultural Adaptation Template (the CAT) (Dyball and Newell, 2015), presented in Chapter 2 – to advance the social enquiry in food systems. Critical reflexivity is a core component of qualitative research (Hay, 2008; Moon *et al.*, 2016; Richards, 2014; Sayer, 2009). In the growing field of sustainability science, researchers need to apply critical skills in reflecting on how their role in research projects may influence their immediate interpretations and the relations they build throughout their projects (Haider *et al.*, 2017). Part of this reflexivity requires researchers to understand how literature concepts and lived experiences shape how we ask questions and interpret our results.

To enable this reflexivity throughout my research processes, I draw on Layder's adaptive theory approach (Layder, 1998; Layder, 2013). The adaptive approach enables researchers to use existing theoretical concepts to inform their research questions, whilst allowing new theory to emerge during the analysis and writing process (Layder, 1998). Layder (1998) proposes the explicit identification of 'orienting concepts' that inform the research design. As orienting concepts, existing theories are understood to be propositions that may or may not be supported by the data, encouraging researchers to be self-critical in their application of the concepts and alert for alternative ideas and counter-proposals. The adaptive approach allows researchers to use these concepts for the initial stages of thematic analysis of qualitative data, supporting deductive inquiry where researchers draw links between raw data and orienting concepts, while also challenging those existing ideas by including inductive reasoning in their analysing. This can help them develop new theories and ideas from the raw data and application of orienting concepts. This is important for the field of sustainability science, where different disciplines and conceptual frameworks merge to advance knowledge. The orienting concepts form part of the initial context for studying the links between food discourses, human ecology, and food systems.

The three major orienting concepts that informed this study were:

1. food systems as a research domain,
2. the prevalence of the market-based food security discourse across food literature and dominant approaches to food and nutrition challenges, and
3. the critical elements of food sovereignty discourse and their role in addressing food and nutrition security challenges.

These concepts are expanded on here and re-introduced throughout individual manuscripts in this thesis to meet the requirements of specific publications. The remainder of this chapter introduces the core ideas and critiques of each of the three orienting concepts, with a more comprehensive

literature review presented in Chapter 3 (Davila and Dyball, 2018). To contextualise these orienting concepts, I now present the major research questions that drove this study.

1.3 Food and nutrition security in a changing world

We are currently living in the Anthropocene, an era in which human activities significantly impact Earth's systems and continue to alter planetary functions (Steffen *et al.*, 2011). Agricultural activities are major drivers of both environmental change and human development during the Anthropocene (McIntyre *et al.*, 2009; Rockström *et al.*, 2016). Agriculture is the single most extensive form of land-use, with approximately 40% of the planet's landscapes being used for croplands and pastures (Campbell *et al.*, 2017; Foley *et al.*, 2005). This landscape modification has affected biodiversity through deforestation, soil degradation, habitat loss, fragmentation, desertification, and depletion of water resources (Chaudhary and Kastner, 2016; Foley *et al.*, 2013). Agricultural activities alone contribute to 11% of anthropogenic greenhouse gas emissions, increasing to between 30% to 50% when all other food activities ranging from production to consumption are included (Campbell *et al.*, 2017; GRAIN, 2011; IPCC, 2017; Vermeulen *et al.*, 2012)[1]. This drive to modify landscapes has been accelerated by the policy pressures of managing food demand from increasing populations, expected to meet nine billion by 2050 (Horton, 2017). Food systems will need to adapt to both changing food demands and declining ecosystem integrity, whilst also reducing the impact future food activities have on environmental change and human wellbeing (Grafton *et al.*, 2015; Springmann *et al.*, 2018). Doing so requires food systems to transform in order to meet the critical human development and environmental challenges of the 21st Century (Caron *et al.*, 2018).

The FAO estimates that out of the world's seven billion people, 821 million are hungry and one billion are malnourished while two billion are obese (FAO, 2018). That is, over half of the world's population is not able to either access healthy and nutritious food, or make adequate food choices to meet their individual food and nutrition security (IPES Food, 2015). Despite progress in reducing malnourishment during the United Nations Millennium Development Goals, a mix of political unrest, price fluctuations, and natural calamities continue to threaten food and nutrition security outcomes throughout the world (FAO, 2017; Lang, 2010; Van Der Ploeg, 2010). The highly political nature of food, where corporations and governments seek to maintain agricultural industries, feed populations, and adapt to a changing climate, make governing food systems a highly complex challenge (Caron *et al.*, 2018). In its efforts towards eradicating hunger, the United Nations continues to pursue food and nutrition security, including it as the Sustainable Development Goal of 'Zero Hunger'. To guide the private, public, and community activities to achieve this goal, the FAO,

[1] Note that in this thesis, Chapter 3, Section 3.3.3, uses the estimate of up to 30% based on only Vermeulen *et al* (2012). This is a published manuscript and thus the figure has not changed. This introductory chapter acknowledges the wider contributions of up to 50% acknowledged by the IPCC of total food related activities, including transport, waste management, and land clearing.

reiterated here from context statement above, continues to define food and nutrition security as "…a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2018 p. 159)

Dealing with food and nutrition security challenges is a hugely complex task: it requires negotiations between multiple actors with varying degrees of power, linking multiple food production, processing, and consumption activities, designing logical policies that minimise unexpected emergent outcomes, and balancing the diverse knowledge systems involved in food decision making (Foran *et al.*, 2014). These competing interests have led to multiple discourses on how to 'solve' food system challenges, such as climate-smart agriculture, sustainable intensification, precision agriculture, bio-fortification, and agroecology – all with their merits and extensive critiques (Brooks, 2011; Fraser, 2018; Loos *et al.*, 2014; Petersen and Snapp, 2015; Taylor, 2017; Tomich *et al.*, 2011). These solutions continue to inform debates among global policy and research communities concerned with sustainably delivering food and nutrition security (IPES Food, 2015; McIntyre *et al.*, 2009). Each of these solutions is created by how both individuals and institutions conceptualise food problems, and will inevitably influence how programs and policies are designed and implemented (Béné *et al.*, 2019). One approach to tackling this complexity has been for stakeholders, including researchers, to frame their approach to food and nutrition security interventions through a systems lens (Ingram *et al.*, 2010). This explicitly focuses on the positive and negative feedback processes in specific systems, and across interacting systems between scales. Systems thinking, applied to food and nutrition security, has supported the concept of 'food systems' to form part of emerging sustainable development research and policy discussions (Béné *et al.*, 2019; Ericksen, 2008a; Ingram *et al.*, 2010).

1.4 Orienting concept one: food systems as a research domain

A food system is commonly defined as the interactions and feedbacks between food activities, ranging from production to consumption, and include a focus on the interacting human and environmental drivers which ultimately deliver food and nutrition security (Ingram *et al.*, 2010; Misselhorn *et al.*, 2012). Interest in the conceptualisation of food in the context of a social-ecological system is not new, with both biophysical and social scholarship engaging with the links between food and human ecological variables. In 1979, Dahlberg stated that most people's conceptual understanding of agriculture failed to capture the basic links between people and their environments (Dahlberg, 1979). Conway (1985; 1987) focused on agricultural ecological systems, and defined the hierarchies of agroecosystems, focusing on productivity, stability, sustainability, and equitability. During the 1980s, a growing response to industrialised food production systems saw a rapid expansion of agroecological science as the basis for sustainable food systems management, with a strong focus on Latin American food production systems (Altieri, 1995; Gliessman, 2007). Sobal *et*

al. (1998) proceeded to define the value of systems approaches, whilst other scholarship focused on systems thinking in agricultural extension (Bawden and Packham, 1993; Ison and Russell, 2000; Ison *et al.*, 1997). In Southeast Asia, the work of Rambo and Sajise (1984) challenged the traditional emphasis of technologies and economic productivity, and emphasised the value of local smallholder knowledge and integrative multi-stakeholder approaches to advancing food and nutrition security.

Parallel to the systems studies into agriculture, political economists advanced theoretical research into the role of capital accumulation, power relations, and markets in influencing food activities. The 'food regimes framework', developed by Friedmann and McMichael (1989), provided a political economy lens for documenting the expansion and concentration of power and capitalist markets, which enabled agricultural systems to maximise technological innovations to meet the growing demand of consumer markets. Through proposing a series of food regimes, Friedman and McMichael gave social science scholars an organisational and historical framework for linking human activity with broader political and economic changes (Carolan, 2016; McMichael, 2009a; McMichael, 2016). In the field of agrarian political economy, scholars looked at how historically-rooted social inequalities led to pervasive hunger and commodity production (Akram-Lodhi and Kay, 2009; Bernstein, 2016; Borras, 2007; McMichael, 2006; McMichael, 2009b). The socio-political literatures of food activities focused on inequalities and power relations, and emphasised the marginalisation of smallholder farmers throughout the agricultural trade and technological development processes (Akram-Lodhi, 2009; Bernstein, 2016; Borras Jr *et al.*, 2008; Byres, 2009; Clapp, 2014a; Desmarais, 2008; Oya, 2009; Patel, 2009; Schiavoni, 2016). The innovations gained through techno-scientific research conducted through the Green Revolution period in the 1960s enabled total food output to outpace population growth – yet despite this progress smallholders remain marginalised from development processes and face poor nutritional outcomes (Carolan, 2016; Lowder *et al.*, 2016; Sen, 1981; Smith *et al.*, 2000). Smallholders continue to produce approximately 34% of total food output (Ricciardi *et al.*, 2018), and remain vulnerable to climate change and institutional responses to food systems (Clapp *et al.*, 2017). The physical and conceptual distance between smallholders and food institutions makes them a critical stakeholder in advancing food system interventions (Clapp, 2015).

Global food institutions and private multi-national companies were responsible for advancing the ideas of the Green Revolution and enabling a highly production-oriented agricultural system (Lee, 2013; Shaw, 2009). Barling and Duncan (2015) argue that nation states, global multilateral bodies, and private corporations have played a major role in advancing dominant approaches to agricultural production. While the technological innovations through machinery, agrochemical inputs, and improved storage and value chain processes have enabled total global food output to outpace population growth, the distribution and accessibility of food remains a critical issue (Chaifetz and Jagger, 2014; Horlings and Marsden, 2011; McIntyre *et al.*, 2009). Critical social science scholarship has examined how such technologically-oriented food systems have benefitted corporate and powerful players in food systems, while marginalising consumers and smallholder

farmers (Clapp, 2014a; McMichael, 2009a). Civil society institutions have been able to advance public concern over the health and equitable dimensions of food systems, for example through advancing organic agricultural agendas and rights-based approaches to food systems (Borras Jr *et al.*, 2008; Desmarais, 2008; Gliessman and Rosemeyer, 2010). Among these people-driven institutions, La Via Campesina emerged in the 1990s as a politically active institution led by farmers from across the world (Desmarais, 2007). The explicit concern for human rights, justice, and sustainable food production practices has enabled La Via Campesina to remain a critical voice in food politics advocating for smallholder concerns in global food systems (Desmarais, 2008; Martinez-Torres and Rosset, 2010; Schiavoni, 2016).

The first decade of the 2000s saw a global commitment by advanced economies to support global development, including eradicating hunger, through the Millennium Development Goals (Hickel, 2016). This institutionally-driven vision enabled a number of programs targeted at economic development in food systems, through initiatives such as the Millennium Development Villages throughout the developing world (Wilson, 2013). Despite economic and social progress in some countries, the Millennium Development Goals were unable to capture the systemic nature of human and environmental systems, perpetuating the status quo of framing food problems as ones of production and technologies, rather than critically developing alternatives for marginalised communities in different contexts (McMichael and Schneider, 2011; Wilkinson, 2015; Wilson, 2013). The growing concern over the intricate relationships between human development and global environmental change presented a series of factors that enabled food scholarship to advance in the late 2000s.

The first factor was the 'food crisis' of 2008, which saw a rapid shift in food supply globally, attributed to a mix of social unrest and environmental drivers (Lang, 2010; Van Der Ploeg, 2010). The changes in food flows throughout global markets led to rapid spikes in food prices, which subsequently led to civil unrest throughout the world. Although the 'crisis' rapidly came back to normality when key commodity prices stabilised, something had shifted: after decades of declining public investment into the agricultural sector (Dethier and Effenberger, 2012; Pardey *et al.*, 2016), there was reinvigorated interest from public and private donors. The World Bank focused its 2008 Global Development Report on agriculture as a major driver of growth in developing countries. These factors solidified the institutional belief that food insecurity remained a global challenge, and required interventions from public, private, community, and philanthropic groups.

The second factor was that advanced food systems scholarship emerged from scientific enquiry into the extent to which humans were influencing global environmental systems. Rockström *et al.* (2009) argued for a 'safe operating space for humanity', where the thresholds of nine biophysical boundaries were quantified and linked to long-term sustainability trends. The identification of these nine planetary boundaries resonated with the global sustainability community. Food system activities, as the major driver of global land use change, were discussed as major contributors to the deterioration of planetary boundaries (Campbell *et al.*, 2017; Rockström *et al.*, 2016). These

scientific advancements, coupled with the developmental challenge of fluctuating food prices, created a context in which global political narratives re-focused on food activities as a major driver of human and ecological change. Within the public policy sphere, the United Nations-led International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD) focused on agricultural decision making in cross-cultural and cross-political contexts, and the inequitable distribution of power within modern food systems (McIntyre *et al.*, 2009). The International Panel of Experts on Sustainable Food Systems (IPES) demonstrated the open acknowledgement of systems thinking for advancing food interventions, and identified the critical role that power and politics play in influencing food system outcomes (IPES Food, 2015).

The third factor that influenced the re-emergence of food systems thinking with explicit concern over human and ecological feedbacks was the rapid growth in sustainability science. Although sustainability research dated back decades, there had been relatively few avenues for expanding traditional disciplinary thinking associated with different sustainability problems (Kajikawa, 2008). As a problem- and solution-oriented field, sustainability science sought to build from previous studies on the nature of scientific enquiry to link practitioners and scholars through research (Lang *et al.*, 2012), explicitly focusing on influencing system behaviour and outcomes (Mitchell *et al.*, 2015).

The focus on developing new theoretical understandings of how humans and ecosystems interact, and identifying practical solutions, provided a platform to develop transdisciplinary research as the core approach to research (Cash *et al.*, 2003; Clark *et al.*, 2011). Transdisciplinary research is research that addresses issues of societal and environmental importance, and fosters the integration of multiple disciplines and knowledge systems beyond academia (Blythe *et al.*, 2017; Lang *et al.*, 2012). Research concerned with the integration and co-production of knowledge from different cultures and disciplines (Miller and Wyborn, 2018), provided sustainability scholars with a new way of linking their research to observable social and ecological problems (Brandt *et al.*, 2013; Lang *et al.*, 2012). Food activities, because they span social and environmental systems, create an opportunity to look at food systems within the scientific realm of sustainability science and transdisciplinary research (Francis *et al.*, 2008; Hammond and Dubé, 2012). The rapid, high-level focus on food-systems framings of food and nutrition security creates an opportunity for exploring transformative change, where new ways of framing and intervening in problems challenge traditional discourses and generate new systems behaviours (Caron *et al.*, 2018; IPES Food, 2015; IPES Food, 2017).

The collision of an unfolding food crisis, the defining of planetary boundaries, and advances in sustainability science enabled a re-imagining of the food systems concept (Figure 1). Ericksen (2008a) synthesised previous food systems concepts within an environmental change context, and proposed a framework that captures the social, economic, and environmental feedbacks throughout different food activities, and their effects on food and nutrition security outcomes. Concurrently, the comprehensive study by Ingram *et al.* (2010) documented how the food systems concept applied to

multiple issues of governance, regional research, and global environmental change. The food systems concept as presented by Ericksen (2008a), Ingram *et al.* (2010), and (Ingram, 2011a), offered a research domain to explore how food activities interact with global environmental changes, ultimately affecting food and nutrition security. Bellotti (2017) argues that the food systems concept provides to researchers a situational starting point for research, offering flexibility to explore the nuances of the drivers of food system outcomes. Ingram (2017) looks beyond research, and states that corporate institutions, public institutions, and civil society groups can all use the food systems concept as a platform to design interventions that relate to the full system. Doing so would help break from reductionist notions of maximising production to meet global food and nutrition security objectives, but which fail to consider the wider ethical and socio-political dimensions of food systems. The food systems domain offers an organisational structure for exploring how to feed growing populations in light of changing socio-economic and environmental processes.

The synthesis of food systems as a research domain was presented by Ericksen (2008) in Figure 1. The left-hand side of the diagram shows the major drivers that influence food activities and outcomes: global environmental change and socio-political processes. Global environmental change includes localised processes, such as soil degradation and water depletion, to global processes, such as greenhouse gas emissions and changing weather patterns. Socio-political processes are similarly multi-scale and multi-dimensional, ranging from household gender relations and decision making, to global trade agreements and multinational corporate influence over agricultural inputs. These factors interact with one another across different food activities, such as agriculture, packaging, storage, distribution, consumption, and waste management. At some point in time, these interactions *should* deliver food and nutrition security for any specific food system. For example, all these processes may operate in a household system and meet immediate household food needs. As systems expand in scale and complexity, it becomes much more difficult to distribute food and nutrition security outcomes equitably throughout large populations while minimising environmental harm.

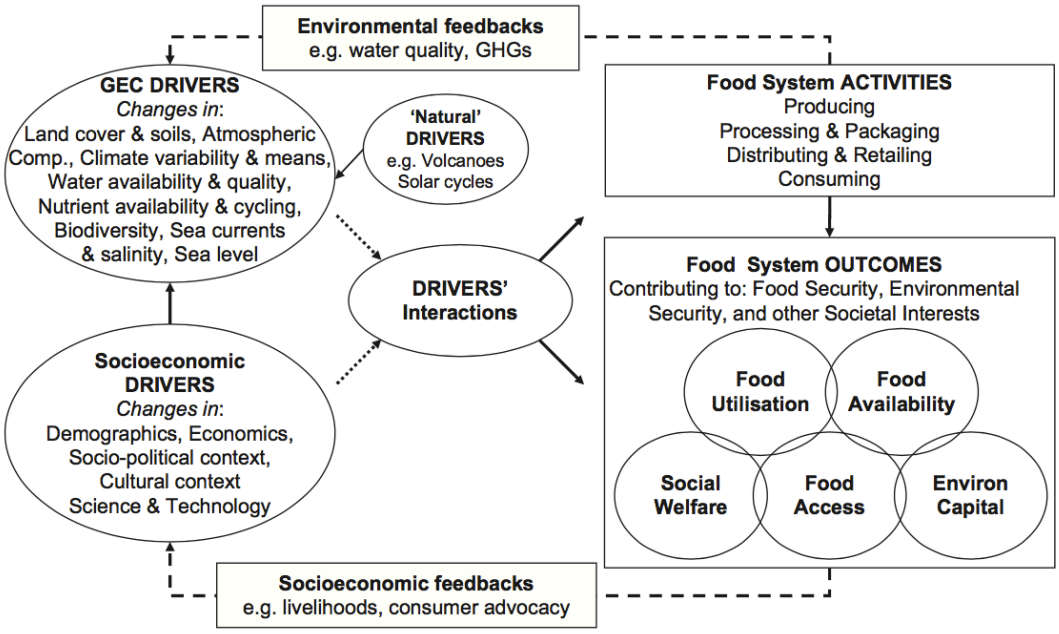

Figure 1: The food systems research domain as developed by Ericksen (2008)[2]

The interactions between food system drivers and outcomes has been studied in depth (Gustafson *et al.*, 2016; Ingram *et al.*, 2010), and work continues to explore how food is governed by multiple actors (Candel, 2014; Hospes and Brons, 2016; Pereira and Ruysenaar, 2012; Termeer *et al.*, 2018). An original critique of the food systems concept was the lack of discussion on the power dynamics embedded in food systems, notably in rural landscapes in developing countries where smallholder farmers continue to be marginalised from development processes (Ferguson *et al.*, 2012). This gap has started to be addressed, with scholarship from agrarian change, political ecology, and political economy situating analysis of social dynamics within a changing environmental context (Blay-Palmer *et al.*, 2015; Clapp, 2015; Galt, 2016; Galt, 2013; Hall, 2015; Horton *et al.*, 2017). There has also been ongoing debate of how two major discourses – market-based food security and food sovereignty – contribute to food systems research and practice. This thesis contributes to this link between the study of food discourses and how they are embodied in food systems research.

1.5 Food discourses

Discourses are a critical element of social enquiry (Hook, 2007). They drive the way we create and use knowledge, inform our individual and collective action, and influence our social and power relations with each other (Dryzek, 1997). Discourses extend beyond the way we do things – they are embedded in how we frame our values and belief systems in everyday life. In the environmental discourse context, Hajer and Versteeg (2005) and Dryzek (1997) discuss environmental discourses,

[2] Global Environmental Change (GEC). Comp. is an abbreviation of Composition. Environ is an abbreviation of environmental. Figure is unedited and is presented as published by Ericksen (2008).

ranging from market oriented ones focused on economic gains and productivity, to 'green' discourses concerned with sustaining environmental systems. Stevenson and Dryzek (2012) argue that people are conditioned by discourses, which therefore influence the actions they take in their daily lives. Discourses shape how individuals make decisions, including by implicitly or explicitly defining what is 'right', and subsequently they influence how formal and informal institutions create rules for societies to follow (Dryzek, 2016). At its core, a discourse is an ensemble of ideas, produced and perpetuated through action, through which humans give meaning and interpret social and environmental phenomena. Importantly, multiple discourses exist at the same time, often making it difficult for those who subscribe to one discourse to comprehend the actions and understandings of the world of those who subscribe to other discourses (based on the work of Dryzek, 1997; Hajer and Versteeg, 2005). The difference between discourse and paradigm is discussed by Dryzek (2007) as being subtle but important. Paradigms are often recognised by individuals and societies, and initiated through disciplines (for example, evolutionary biology). Differently, discourses are ingrained in individuals and society, making subjects frequently unaware of their presence (Dryzek, 2007).

The past four decades presented a growth in critiques of the language of food security, stimulating growing interest in food discourses. The pioneering work of Sen (1981) argued that the language of productivity in food security policies failed to concentrate on access, creating a new wave of reconceptualising of how to meet food demands. Sen (1981) proceeded to discuss the role of democratic decision making and participation as being a fundamental component of eradicating hunger, as it can enable marginalised voices to participate in food decision-making processes. Smith *et al.* (1992) analysed the diversity of language used to define 'food security', showing that the definitions varied depending on context and purpose. Lang and Heasman (2004) debated the differences between production-oriented and ecological food paradigms, with a focus on health outcomes from food systems. Focusing on definitions of sustainability within food systems research, Béné *et al.* (2019) identify that human diet and environmental metrics are prioritised in framing of food challenges over wider issues of social sustainability, such as rights and justice. Alternative food production practices have also been examined through agroecosystem and socio-political studies, notably in comparisons between industrialised systems and agroecological production (Altieri, 1995; Altieri and Toledo, 2011; Carolan, 2016). In an analysis of the changing practice and thinking of agroecological discourse, Rivera-Ferre (2018) emphasises how discourses can be appropriated by more powerful discourses that perpetuate the status quo rather than transform food systems. Similar analysis of commonly used 'solutions' to food systems, such as climate-smart agriculture and sustainable intensification, are increasingly presented as tools for addressing environmental problems in agricultural systems (Petersen and Snapp, 2015). Yet major socio-political issues within these 'solutions', such as addressing gender inequality or offering genuine transformations towards equitable distribution of agricultural development, remain absent from the technical solutions (Collins, 2017; Taylor, 2017).

In the inaugural issue of the journal *Food Security*, Pinstrup-Andersen (2009) stated that food security is a dynamic concept that needs to be reflected on and adapted as contexts change. Other authors have brought the food discourses debate to the forefront, for example Carney (2011a; 2011b), Lee (2007; 2012), the work of Jarosz (2014) and associated responses (Blay-Palmer *et al.*, 2014; Carolan, 2014; Clapp, 2014b; Edelman, 2014; Lyons, 2014; Murphy, 2014). Dekeyser *et al.* (2018) and Chaifetz and Jagger (2014) synthesise the history of food sovereignty as an alternate discourse. These authors argue that food and nutrition outcomes can be improved through critiquing the nature of decision making processes in food systems, and identifying ways of democratising and increasing participation in food decisions. Finally, the work of Roman-Alcalá (2016) and Schiavoni (2016) advanced food sovereignty scholarship through examining the relational nature of market food security and food sovereignty processes, arguing that the current state of the debate lies in exploring how both discourses co-existing in particular contexts create particular pathways for food systems. Both discourses are introduced and critiqued below, and are comprehensively reviewed analytically in Chapter 3 (Davila and Dyball, 2018).

1.5.1 Orienting concept two: food security discourse and globalised market systems

At the height of a global shortage of food in 1975 the UN defined food security as "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (United Nations 1975, cited in FAO, 2003). Since then, the definition has expanded from being about producing and distributing food to concerns of public health, nutrition and social control, as well as scale, ranging from household to international (Patel, 2010; Smith *et al.*, 1992). Since the 1974 definition, the language used to define food security has diversified to over 200 definitions (Maxwell, 1996; Shaw, 2007; Smith *et al.*, 1992). The common definition of food security presented in section 1.3 guides the common institutional responses to improving access, availability, stability, and utilisation of food throughout the food system. The language constituting this definition suggests the purpose of food security is to ensure perpetual availability of food in markets for people to access. While there is extensive critique of the technicalities and language of food and nutrition security (Pinstrup-Andersen, 2009; Smith *et al.*, 1992; Smith *et al.*, 2017b), I use the official FAO definition throughout this thesis as it is a common language that captures the discourses embedded in the institutions seeking to achieve food and nutrition security. The importance of the current definition is that it is now widely acknowledged by more than the FAO, and used by other global agencies tasked with research, policy, and programs in food security. These agencies include, for example, the United Nations Children's Emergency Fund (UNICEF), the World Health Organization, and the World Food Programme.

Critical literature on the market-oriented nature of food security frame it as a discourse that has maintained focus on maximising total agricultural output, and generating a range of negative

environmental and human wellbeing outcomes. For example, it has tended to prioritise the focus of agricultural yields over diversity and quality of produce, leading to long term land use changes and negative environmental impacts (Campbell *et al.*, 2017; Farsund *et al.*, 2015; Ingram, 2011a). The focus on agricultural commodities has led to globalised trade systems that benefit urban consumers in affluent countries, but continue to create negative market and environmental pressures on farmers and ecosystems in food-producing countries (Clapp, 2015; Clapp, 2017; Davila and Dyball, 2015; Porter *et al.*, 2014). The pressure on land use in developing countries has been particularly pronounced, with demand for cash commodities such as palm oil and sugar leading to major habitat degradation and loss of biodiversity (Chaudhary and Kastner, 2016).

Focusing on production since the emergence of the food security discourse has led to global yield increases reaching a level at which the basic caloric intake of the global population can be met (Pinstrup-Andersen, 2003; Pinstrup-Andersen, 2009). As noted earlier, poor access and knowledge on utilising food in a healthy manner has led to both continued hunger and increasing obesity throughout the world (Lawrence *et al.*, 2010; Ng *et al.*, 2013). On the consumption side of the system, the increased presence of food has meant more waste to manage, creating major waste challenges, notably as urban centres continue to consume highly processed and packaged foods (Cloke, 2013).

Carney (2011a) argues that the food security discourse has driven policies which focus solely on productivity and enhanced supply of food in markets, assuming that livelihoods and access to food would increase from market surplus. High-yield and output-oriented agriculture has led to large-scale industrial farming systems (Obersteiner *et al.*, 2010), which has proven to have detrimental impacts on ecosystems (Gliessman, 2007; Swinton *et al.*, 2007) and excluded smallholder farmers from the industrial food system (Cooke *et al.*, 2009; ETC Group, 2009; Martinez-Torres and Rosset, 2010). Focusing on food output as the major driver of a food system has thus become widely accepted as insufficient to meet the growing nutritional and environmental burdens being felt in food systems, with a transition by global research centres and policies towards the broader elements of food security: access, stability, and utilisation (FAO, 2017). Access is concerned with physical and economic capacity to obtain food products that are healthy and culturally appropriate. This access, however, is determined by the stability of markets to deliver food to marginalised populations, many of which remain in rural areas with poor infrastructure and market access. Utilisation of food relates to the knowledge and capacity to convert raw food into edible meals, and has strong associations with culture and place (Briones Alonso *et al.*, 2018). These pillars of food security are highly nuanced and influenced by multi-scale feedback processes, and form part of the dominant market food security discourses present in institutions. For example, Diether and Effenberger (2012) argue that countries must improve their productivity and develop higher-yielding crop varieties to ensure access to food. Similarly, Thompson and Scoones (2009) argue that current agriculture development pathways taken by governments and non-government organisations (NGOs) in Africa and Asia follow the same technocratic and output-oriented model of the Green

Revolution, which seek to enable availability of food in markets. These approaches follow the discourse of food security that strives for market availability of food commodities. Fairbairn (2010) argues that food security discourse presents current food systems as an outcome of market forces, whilst Lee (2007) states that food security falls into economic rationalist thinking, which focuses on markets and trade to preserve surplus of commodities.

Many have argued that the past food security approaches to addressing hunger have been controlled by public and private institutions. This has come at the cost of including the voices and needs of smallholder farmers, which have been estimated to produce between 35% and 70% of total global commodities (ETC Group, 2017; Herrero *et al.*, 2017; Ricciardi *et al.*, 2018)[3]. In Southeast Asia, very small farms of less than 2 hectares contribute 30% of commodities to the region (Herrero *et al.*, 2017). This indicates that food security remains focused on meeting market demand for staple commodities, rather than focusing on the diversified output of small-scale farmers and the provisioning of food for all people, not just those with market access. Through this, food security has become a discourse heavily driven by top-down governance systems, where localised communities are heavily affected by how trade and global food systems behave (see for example Desmarais, 2007; Martinez-Torres and Rosset, 2010). Such discourses promote globalised trade, often focusing on major cash commodities required to produced highly processed food or provide feed to increasing demand for meat of a growing population. As a critical alternative to this globalised, cash-commodities-centred market system, the discourse of food sovereignty emerged in the 1990s as a way of organising collective action and proposing new processes, focused on environmental sustainability and social justice, for achieving food and nutrition security.

1.5.2 Orienting concept three: food sovereignty discourse

As the critiques of the market food security discourse grew in the literature, citizen groups and smallholder farmers from throughout the world proposed a radical alternative pathway to feeding the population: food sovereignty. As distinct from food security, which is more technical and measurable, food sovereignty is ethical – it is concerned with the right of farmers, consumers, and individual nations in influencing their food production systems and food choices without depending on the markets that drive the globalised food system (Anderson and Bellows, 2012; Anderson, 2008; Desmarais, 2007; Wittman *et al.*, 2010). Originally discussed in policies in Latin America, food sovereignty is concerned with the *processes* that lead to a system outcome as defined by its own community (Dekeyser *et al.*, 2018). The concept thus aligns with Sen's (1981) concern over food access and democratic choice, and brings to light the way in which market oriented approaches to food security have marginalised farmers, consumers, and nations.

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[3] The wide attribution bracket relates to how a 'small' farm is defined. ETC Group (2017) fails to specify a farm size. Herrero *et al.* (2017) attribute 56% of production of 41 crops, 7 livestock, and 14 aquaculture and fish products across 161 countries to farms of less than 50 hectares. Ricciardi *et al* (2018) estimate that 30-34% of global food supply, by calories and based on 55 countries, comes from farms of 0-2 hectares.

Food sovereignty was formally cemented as a politically alternative process for achieving food and nutrition security through the Nyéléni Declaration. Within it, food scholars, farmers, community activists and social movements collectively defined food sovereignty as:

> …the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. (Nyéléni Declaration, 2007)[4]

Food sovereignty focuses on the *processes* that enable food and nutrition security being achieved, in contrast to market food security discourses which focus on the *outcome,* without regard for the pathways taken to get there. Food sovereignty proposes political organisation and collective action to change food systems towards the benefit of environment and communities. This collective action and environmental sustainability discourse makes food sovereignty a politically loaded discourse that openly seeks to critique the dimensions of justice and fairness in highly complex and globalised food systems.

The food sovereignty discourse emerged as a critical response to the neoliberal model of agriculture embedded in international development and agricultural trade (Desmarais, 2007; Wittman *et al.*, 2010). Within food sovereignty discourse, there is an explicit concern for rights to influence decisions and environmental sustainability. The rights dimension of food sovereignty focuses on framing food as a right that should be available to all people, as opposed to a market commodity only for those with the financial resources to access and the knowledge to utilise it in a healthy way (Desmarais, 2007). Whilst food security discourse developed through international institutional settings (FAO, 2003), food sovereignty discourse emerged from social movements in the developing world to demonstrate frustration and dissatisfaction towards the existing agricultural development policies of the time (Windfuhr and Jonsen, 2005; Wittman *et al.*, 2010).

Food sovereignty discourse is frequently associated with strong environmental and human wellbeing-oriented practices and outcomes. The discourse has emerged from an active social movement of consumers and producers from developed and developing nations that seek to challenge the status quo in national food policies and international trade structures. Agricultural practices receive strong attention within the discourse, partially due to the smallholder origins of the discourse, and the principles of agroecology promoted as alternate production practices (Altieri and Nicholls, 2008; Altieri, 2009; Desmarais, 2007; Wittman *et al.*, 2010). Agroecological production seeks to mimic nature and improve biodiversity on farms, and is embedded in food sovereignty discourse as an agricultural way of enabling localised knowledge to create dietary diversity,

[4] It is important to note that the first formally recognise definition of food sovereignty emerged from La Via Campesina (Via Campesina, 1996). The Nyéléni Declaration, however, is recognised in the literature as a critical juncture moment where social movements, scholars, and activists confirmed the relevance of the concept in food systems thinking and practice.

culturally appropriate food practices, and sustainably managed landscapes (Francis *et al.*, 2008; Gliessman, 2007; Tomich *et al.*, 2011).

The language of food sovereignty was brought to the fore by the international farmer group La Via Campesina (Desmarais, 2007; Via Campesina, 1996). Since its introduction, the language used in the definition of food sovereignty has expanded and become complex, integrating references to agrarian reform, gender equity, indigenous knowledge, anti-neoliberal markets and specificity on agroecological production (Patel, 2009). At its core, food sovereignty presents a critical and radical set of principles that challenge social, economic, and environmental degradation throughout the world's food systems. The principles of food sovereignty, are summarised by Windfuhr and Jonsen (2005) as focusing on:

- Framing food as a basic human right rather than a market commodity
- Enabling access to productive resources
- Mainstreaming agroecological production
- Critiquing trade and enabling local markets

As with market food security, food sovereignty is not without its critiques. One major critique of the food sovereignty discourse is its tendency to lean towards local food systems, ignoring that a number of nations' immediate food needs are dependent on food produced in foreign landscapes. A commonly used example of this is Japan, which has a national food system that delivers rice and a few basic commodities, whilst the majority of protein, fruit and vegetables are imported from industrial agricultural systems elsewhere (Porter *et al.*, 2014). Food sovereignty proponents provide little commentary on the role of international trade and markets as in feeding growing populations and dealing with famines. Some trade scholarship within food sovereignty suggests that it is not trade *per se* that is bad, but rather the terms under which nations and farmers are held to deliver to international trade systems (Burnett and Murphy, 2014). These terms of trade, largely designed by powerful and affluent Western nations, tend to marginalise food producers from developing countries through tariffs and structural adjustment programs, while affluent nations are able to subsidise and create an overflow of food into global markets. The sheer scales of production mean that smallholders are unable to compete with the low prices offered by imports from more industrialised systems (Hickel, 2017).

Another major limitation of the food sovereignty discourse is that it assumes providing farmers with the ability to influence their food systems will lead to improved nutritional outcomes, environmental wellbeing, and cohesive rural communities. This may not necessarily be the case, for example in communities where there is little knowledge on the importance of micro-nutrients for child development. Other critics point towards what happens when democratic control over a food system is enabled, and the rapid turn to inequitable social arrangements and dependence on market systems that emerge. In a study in Sulawesi, Indonesia, Li (2014) found that farmers independently chose to convert from subsistence systems to mono-crop systems in pursuit of incomes to support

their families and improve their food security. This led to a rapid conversion to highly market-dependent livelihoods, where debt cycles to support mono-crop systems emerged and re-structured the social relations between farmers and the new buyers. This rapidly created inequalities within communities that previously had strong social cohesion.

A further critique of food sovereignty is the need to clarify who is being 'sovereign'. This can range from the individual, the community, to the nation state (Hospes, 2013; Roman-Alcalá, 2016). There might be multiple sovereign actors co-existing at one time and negotiating with each other, which can lead to new forms of power relations and inequality as everyone works toward ascertaining their 'sovereignty'. Experiences and framings of food sovereignty are highly relational, where sovereignty is not homogenous across farming systems globally, but rather is informed by the social, economic, and environmental context in which food producers, businesses, and consumers operate (Shattuck *et al.*, 2015). Revealing the relational nature of food sovereignty requires investigations into different perspectives and applications of sovereignty across food systems (Roman-Alcalá, 2016). This relational approach requires analysis that connects the localised, nuanced nature of food challenges and discourses, and situates them within the agroecological and political ideas embedded in food sovereignty.

While both discourses presented here are heavily debated in the literature, empirical studies using sustainability-oriented frameworks that compare the co-existence of discourses remain limited. Food and nutrition security studies are abundant, with a strong legacy of agroeconomic and biological studies into yield, and more recently, nutritional outcomes from agricultural systems. Food sovereignty scholarship has advanced the discourse through documenting a mix of political, economic, and qualitative research into smallholder producers, consumers, and policy examples of how food sovereignty is manifested (Chaifetz and Jagger, 2014; Patel, 2009). With growing trends towards transdisciplinary research in food systems, where multiple stakeholders produce, conduct, and create new knowledge to influence a particular problem, it is critical to find tools for linking abstract discourses with observable human responses (Francis *et al.*, 2008). These two discourses fall within the scholarship of the political and social sciences. This provides food systems scholarship with an opportunity to embed critical discussions of social relations and power, and their subsequent influence on food systems.

1.6 Thesis structure

To advance the study of discourse within food systems, I have structured this thesis into two major sections, with a third synthesis section. I first present a methodological development section (Chapters 2-4), and second an empirical testing of theory through case studies (Chapters 5-7). The adaptive approach embedded in the design of this study means that the application of the framework throughout the research enabled me to test how human ecology, as a systems-based analytical framework, illustrates the links between food discourses and food systems research. In Chapter 8, I

synthesise the different scales and issues covered into the major knowledge contributions of the thesis.

This is a thesis by compilation. All five core chapters (Chapters 3 to 7) have been written as academic research manuscripts and at time of submission are either published, submitted, under review, or in advanced preparation. Along with the manuscripts, I have produced three additional chapters: This introduction (Chapter 1), the methodological approach (Chapter 2), and a concluding discussion which synthesises the major arguments (Chapter 8).

In **Chapter 2**, I document my ontological, epistemological, and theoretical foundations. These foundations position human ecology as my overall methodological approach towards studying discourses in food systems. Human ecology provides the conceptual platform for looking at the literature and data analysis carried out in the rest of the thesis.

In **Chapter 3**, I document how the human ecology Cultural Adaptation Template (the CAT) acts as an organisational framework for analysing literature using two different discourses analytically (Davila and Dyball, 2018). Through focusing on the food security and food sovereignty discourses as introduced in this chapter, Chapter 3 provides an example of how human ecology enables analysis of food systems literature and the discourses embedded within it.

In **Chapter 4**, I introduce an in-depth human ecological and historical overview of the Philippines food system. Using interdisciplinary literature from economics, history, agriculture, social science, sustainability science, I narrate how the macro-economics of the Philippine food system has led to a maladaptive system. Maladaptation, as per human ecologist Stephen Boyden (Boyden, 2016), is defined throughout the thesis as the situation that emerges from lengthy cultural and institutional processes that have led to unnecessary distress in human wellbeing and ecosystems. In such maladaptive systems, smallholders are unable to overcome poverty traps created by historical legacies that have supported policies incentivising the production of cash commodities. The paper demonstrates how human ecology is a valuable conceptual framework for identifying the competing discourses in a particular food system, and their historical origins.

In **Chapter 5**, I demonstrate how systems thinking and human ecology can be used by food systems practitioners and researchers in an applied context. Leveraging from regional initiatives to advance transdisciplinary food systems research in Southeast Asia, I document how researchers and policy-makers from four Southeast Asian countries conceptualise issues of food and nutrition security, and the subsequent implication of these framings for emerging transdisciplinary research agendas in the region. The analysis of workshop findings shows that even though there is high interest in implementing transdisciplinary research, smallholder farmers are continuously framed as passive recipients of technical services and agricultural extensions. I argue that such framings are incompatible with the explicit objectives of regional agendas to expand transdisciplinary and participatory food systems research.

Chapter 6 and Chapter 7 include a human ecological analysis of semi-structured interview data from smallholder farmers in Inopacan, Leyte, the Philippines. Both chapters present a detailed case study of smallholders' experiences in working in a cash commodity system, and the implications of this system for their immediate household food and nutrition security. **Chapter 6** focuses on the way smallholder farmers frame food security, and the implications of this framing for the type of support they seek and receive in their food system. The interviews present narratives of *food security as market driven*, perpetuating discourses that food security is attained through maintaining the current food systems. I argue that this leads to systemic behaviours that enable poverty traps, hindering farmers' capacity to diversify and to break socio-political barriers in their food system. **Chapter 7** presents smallholders' perceptions of pathways to improve food and nutrition security while adapting to environmental change. I present two discourses that exist in a relational manner, responding to the economic and environmental context of agricultural production in Inopacan. Smallholders speak of 'cleaning the land', clearing forest understoreys as a strategy simplify agricultural landscapes, which they perceive as an adequate strategy to produce more coconuts. At the same time, smallholders discuss the urgency to adapt to environmental change, experienced in the form of intense weather events, increased heat stress, declining soil quality, and lack of access to freshwater resources. To adapt to climate change, smallholders discuss agroforestry and diversification into high value trees for timber and fruits as a way of using markets to improve food security and simultaneously adapt to a changing environment. This pathway, however, does not receive the institutional policy support to enable farmers to change their practices, essentially locking them into the 'cleaning the land' discourse and its associated practices. **Chapter 8** provides a synthesis of the five academic manuscripts produced, and the theoretical, research, and policy implications of my thesis.

An overview summary of the thesis structure and relevant questions is in Table 1.

Table 1: Thesis questions and relevant chapters

Primary Research Question:	
To what extent does a human ecology framework help capture links between food discourses and institutional behaviours in food systems?	Answered throughout thesis, summary in Chapter 8
Sub-question	**Relevant Chapter**
How does the human ecology framework help guide analysis of food system discourses?	Chapter 3, Chapter 4
What discourses exist among policy and research groups responsible for food and nutrition security activities?	Chapter 5
What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?	Chapter 4, Chapter 6, Chapter 7

How do these theoretical and empirical findings contribute to advancing food systems and human ecology scholarship?	Chapter 8

The manuscripts published or under review for this thesis (Chapters 3-7) may vary slightly in language and spelling to adhere to specific journal requirement. For coherence, I have made all figures and tables follow standard numeric sequence for the full thesis. Besides figure and table captions and in-text reference changes, all of Chapters 3-7 are as published or as under review by the relevant publication.

1.7 Thesis boundaries

This thesis is bounded to the component of the food system concerned with agricultural production and associated discourses. While this is the focus, I carry out the analysis into agricultural activities within the broader understanding that they operate in the context of rapid changes in consumer markets, in socio-economic contexts, and in the environment. As a human ecology thesis, system-wide issues such as biodiversity loss, climate change, and inequality of decision making in policy are core to the context of studying agricultural activities. Although this thesis covers a breadth of disciplinary literatures to analyse the ecological, institutional, discourse, and human wellbeing components of food systems in different scales and contexts, there are inevitable analytical boundaries. Like all research, the selection of analytical frameworks, mental models, and ideas will guide analysis and discussions in a particular direction. My focus on the synergies between human ecology, food systems, and food discourses leads this thesis down an analytical line in which system variables are analysed in light of competing framings and discourses. As such, the thesis does not cover these other major critical topics in food systems research and policy, such as:

- The role of gender within both food discourses, which is a core driver in achieving food and nutrition security outcomes across scales. Gender dynamics in rural landscapes continue to profoundly influence household food and nutrition security (Akter *et al.*, 2017; Doss *et al.*, 2017). Critical engagement of gender theories within the human ecology and systems thinking frameworks remain a critical knowledge gap, however my thesis sought to first understand core food discourses in the context of food systems research. These foundations can be used to pursue further analysis of gender theories and discourses with a human ecology approach.
- Fisheries and food security, which play a major role in feeding rural populations, and are facing major resource depletion and impacts of climate change (Blythe, 2015). Fisheries research from a social science analytical perspective are also a major research gap to fill within food literature (Barclay *et al.*, 2017). Parallel work to this thesis is being conducted by Philippine colleagues in fisheries, allowing us to identify synergies and differences of discourses in different food activities.

- Consumer behaviours and their role in food systems, which remain largely understudied within the food systems frameworks and require critical interventions to overcome obesity epidemics and improve the nutritional status of the global population (Kneafsey *et al.*, 2013).
- Indigenous food systems, which remain critical in retaining local cultural approaches to human–food interactions and activities (Dressler and Pulhin, 2010). Indigenous knowledges and traditions are core to food sovereignty movements and discourse (Wittman *et al.*, 2010). Indigenous knowledges are also core to the agroecological literature and have documented richness in supporting native food varieties and culturally appropriate production practices (Altieri and Toledo, 2011; Dressler and Pulhin, 2010).
- Urban–rural linkages, which are a critical area of study both for environmental sustainability and ethical dimensions of food systems (Clapp, 2015; Olsson, 2018; Porter *et al.*, 2014). This was not the focus due to my interests in exploring food discourses as they exist in rural landscapes, advancing our understanding of how discourses are generated in rural contexts (McCarthy and Obidzinski, 2017).

Themes associated with the major topics above emerge throughout the various discussions raised in the prepared manuscripts, however they remain in the periphery of how I applied food discourses within a human ecology framework.

Having provided the thesis context and overview, I now proceed in Chapter 2 to introduce the methodological foundations and data-collection methods carried out in this project.

Chapter 2: Methodological Approach

2.1 Introduction

This chapter provides an overview of the ontological and epistemological foundations of my thesis. Part of the reflexive process as a social scientist is to continuously acknowledge how philosophical foundations influence how we ask questions and interpret observations (Moon *et al.*, 2016; Salas-Zapata *et al.*, 2013). As Layder (1998) emphasises, research as an human process is connected to basic philosophical principles, and cannot be theory neutral. Consequently, this requires an explicit acknowledgement of the philosophical foundations of the enquiry being conducted. Ontology and epistemology, and the intricate relationship between them, influence how we choose to interpret observations made throughout the research process. Ontology is concerned with the study of being, questioning what actually exists in the world for humans to study (Lövbrand *et al.*, 2015; Moon and Blackman, 2014). Acknowledging ontological foundations enables researchers to clarify the nature of the knowledge they produce and how legitimate it is within the multiple ways of understanding a problem. Epistemology relates to how humans choose to validate and acquire knowledge about a particular phenomenon, thus influencing choice of methods, hypothesis, research questions, and analytical approaches (Crotty, 1998; Midgley, 2000).

In this chapter, I focus on relational ontology (Goodman, 2001; Slife, 2004) as a way of studying the links between food sovereignty and food security in a smallholder farming context. Relational ontology allows researchers to study the relationships between the nature of a problem (for example, hunger and malnutrition), the context in which it exists (for example, rural Philippines), and the way humans respond to the situation (for example, through producing more food). Social phenomena, such as food insecurity, are a product of the interactions between human and their economic and natural resource contexts. Policy and associated discourses to solve this food insecurity develop as such phenomena are witnessed, experienced, and addressed. This creates a situation where humans both live within and affect the processes they attempt to understand and address. A relational ontology emphasises such links between context, lived experience, and the interpretations of 'what exists'. Epistemologically, I take a constructivist approach to interpret the relationship between peoples' experiences and practices in food systems, with a focus on food production. Constructivism helps look at people's perceptions and ideas in relation to each other and the social and political context in which those ideas are presented (Crotty, 1998). Constructivist epistemology is useful for the adaptive approach from Layder (1998), as it enables the mix of orienting concepts and understandings of how people create realities around them, and the implications of these realities for their every-day action (Moon and Blackman, 2014). These ontological and epistemological foundations underpin my use of systems frameworks, in my thesis

I use human ecology to understand smallholders' food security and food sovereignty discourses in a Southeast Asian context.

2.2 Relational ontology and food systems

A relational perspective focuses on the processes and interactions that link components of a system, rather than examining entities in isolation (Wyborn, 2015). Interventions to problems cannot be understood as independent, rather are created as a response to their immediate context. Relational approaches help elucidate how social relations and the political nature of problems evolve over time, and influence how actors and institutions respond to situations (Wyborn, 2015). Relational ontology is salient for sustainability studies, as it emphasises relationships and power relations between actors. Major sustainability challenges are wicked (Brown *et al.*, 2010), driven by multiple causes, have multiple contested interest groups, and have inevitable power relations within them that prioritise access to knowledge and resources to certain groups, marginalising others. This marginalisation of knowledge access is discussed throughout the thesis, notably in Chapters 5, 6, and 7. The contested nature of 'how' to achieve a sustainable food system requires critical analysis of the discourses that drive and motivate people's interactions with their food systems.

Addressing contestation of knowledge requires a type of enquiry that does not assume one claim is more valid than another, and is rather concerned with building shared understandings between conflicting perspectives in light of rapid environmental change and social injustices (Abson *et al.*, 2017; König, 2018; Ravetz, 2006a). Shared understandings of problems can be facilitated through methodological enquiry that seeks to understand how different groups of stakeholders perceive and frame the structural nature of sustainability problems, such as food and nutrition security. Such enquiry towards seeking shared understandings through stakeholder engagement needs to link the quantitative and qualitative nature of resource use without disregarding the validity and legitimacy of knowledge produced by different actors across diverse cultural contexts (Clark *et al.*, 2016; Funtowicz and Ravetz, 1993). This enquiry needs to embrace the knowledge and values of the broader community that are affected by a problem and whose opinion about proposed interventions must be genuinely taken into account (Ravetz, 2006a). The knowledge produced in such contexts will have an explicit normative interest in improving the state of human and environmental systems.

Relational ontology, through focusing on the interactions between knowledge and context, supports methodological enquiry that seeks to identify some of the competing stakeholders' understandings of a problem. The diverse range of political and environmental processes driving food systems' behaviours, introduced in Chapter 1, shows the relational nature of institutional responses. Dealing with issues such as environmental change, malnutrition, consumer behaviour, and socio-economic trends, require people to frame interventions as a response to their context and understanding of a problem. The food discourses introduced in Chapter 1 as orienting concepts (market food security, and food sovereignty), are inherently relational in two ways. First, they are

relational to the food *insecurity* context at a specific scale. Food insecurity has multiple drivers, be it gender household differences, socio-economic barriers to purchase food, or unhealthy eating behaviours, among many. These diverse contextual experiences of food insecurity inform how policies, corporate, and general public strategies are designed and implemented, as will be shown in Chapter 4's analysis of Philippine historical responses to food security. The socio-political context of a food system also influences the extent to which 'sovereignty' and the ability to inform food security strategies are able to be led by individuals in more 'bottom up' governance structures, or imposed by markets and institutions through more 'top down' governance structures. The reality of many food system contexts is that a mix of individual and institutional led approaches to managing food exist, providing the second relational aspect of food discourses: their relation to each other.

The relational nature of food security and food sovereignty was summarised by Jarosz (2014). The historically politically active language of food sovereignty emerged from civil society institutions and farmer groups, enabling explorations of power and social dynamics in food systems (Chaifetz and Jagger, 2014; Wittman *et al.*, 2010). In contrast, food security became largely embedded in neoliberal and global institutions focused on objectively achieving the goal of maximising food output, and more recently, making this output deliver nutritional and environmental outcomes (Lee, 2013; Pinstrup-Andersen, 2009; Westengen and Banik, 2016). While the oppositional nature of both discourses is fruitful for critical debate, it prevents us from exploring how both discourses may exist at one point in time and drive multiple system behaviours (Clapp, 2014b). Throughout this thesis, I show how these food discourses influence the framing of problems and solutions (Chapter 3), the extent to which they are embedded in public institutions in the Philippines and Southeast Asia (Chapter 4, 5) and how smallholders hold dual conflicting discourses on how to improve food system outcomes (Chapters 6, 7). As Jarosz (2014) succinctly articulates, shifting the debate from food sovereignty and food security as opposing discourses towards relational to each other can advance strategies towards sustainable food systems, as it would help embed issues of justice, ethics, responsibility, and caring for humans and nature into interventions in the system (expanded on in Chapter 3). Examining such relations between discourses thus requires a way of understanding how different realities are experienced in specific contexts, and how they create new discourses or amplify existing ones. To do this empirically, I selected methods based on a constructivist epistemology.

2.3 Constructivist epistemology for food systems research

Epistemology informs how researchers select and apply theory in the research process to generate results and new theory (Crotty, 1998). The epistemological foundations of a researcher are important to understand how they, as individuals, interpret and create knowledge about the world (Braun and Clarke, 2008; Moon and Blackman, 2014). Layder (1998) elaborates, arguing that the nature of reality and how we choose to experience it are intrinsically linked, thus influencing how

we choose to understand phenomena through research. For food systems researchers it is essential to outline our epistemological foundations, as they influence how we ask questions, analyse data, and generate recommendations from our empirical observations.

While food systems research is contributed to by multiple disciplines, there remains an opportunity to more deeply embed diversity of epistemological approaches to add to the valuable objective and quantitative studies that continue to dominant narratives of sustainable food systems (Béné *et al.*, 2019; Thompson and Scoones, 2009). For example, the analysis conducted by Béné et. al (2019) demonstrates that different conceptualisations of what 'sustainability' means in food systems has led to an over-emphasises of metrics relating to environmental and nutritional outcomes, at the cost of more holistic sustainability definitions that are concerned with socio-political and ethical issues. Objectivist epistemology assumes that the reality exists beyond the human mind, and remains detached from the subjects, values, and interpretations that exist. Drawing heavily from concepts of resilience and socio-ecological systems, the food systems research domain focuses on 'explaining' how systems behave using metrics and quantifiable variables of change. While these variables may be 'objectively' created through scientific processes, how the metrics are used by individuals to make decisions is a largely subjective process. This is where constructivist epistemology can contribute to food systems studies.

The divergent ways of framing and intervening in food systems allowed me to take a social constructivism approach, where I openly acknowledged throughout the analysis that participant responses are based on their construction of reality and their interactions with their surroundings. This amalgamates well with my relational ontological framing of understanding the interactions between experience and knowledge. Experiences of food security and food sovereignty will vary depending on the historical, socio-political, economic, and environmental contexts of the food system in which different actors operate. In an attempt to comprehend these different understandings and experiences, holistic frameworks able to situate knowledge within their context are required. Using a constructivist epistemological approach enabled my analysis of qualitative research to link people's perspectives to their context, providing an overview of how discourses are embodied by different actors in specific food systems.

2.4 Systems thinking as a theoretical perspective

A focus on links between human and environmental variables requires a theoretical perspective concerned with capturing feedback processes at a particular point in time. Systems thinking offers such a foundation. With an early history of attempting to reduce problems to breakable compartment, systems thinking had strong foundations in biophysical sciences (Ison *et al.*, 1997; Midgley, 2000), progressing to become part of other major disciplines, ranging from engineering to agricultural studies (Ison *et al.*, 1997; Midgley, 2000). Systems thinking has formed part of major sustainability scholarship, such as the seminal theories of institutional analysis (Ostrom, 2009; Ostrom, 2010), resilience thinking (Folke, 2006), Limits to Growth (Meadows,

2008), socio-ecological systems (Fischer *et al.*, 2015), and Earth Systems Governance (Biermann, 2007). Many others have continued to emerge, focusing on human-environmental processes and the various feedbacks that influence a system's governance and outcomes (Ison, 2018). Frameworks focusing on human ecological relations, notably on the normative objective of wellbeing. An example of this is the framework developed by Intergovernmental Platform on Biodiversity and Ecosystem Services, which focuses on six major variables that encompass biophysical, human, and institutional domains (Díaz *et al.*, 2015).

Systems oriented frameworks are useful for progressing sustainability science, as they help identify feedbacks between environmental and social variables in a system (Fischer *et al.*, 2015; Newell and Siri, 2016). With systems frameworks, it is possible to capture the underlying root discourses and institutional structures that inhibit or enable change (Abson *et al.*, 2017; Dyball and Newell, 2015; Meadows, 2008; Midgley, 2000). Soft systems thinking, as an extension of traditionally engineering and prediction based systems models, provide a theoretical perspective for understanding how human decision making operates in light of ecological and economic processes (Checkland and Scholes, 1999; Midgley, 2000). The work of Ulrich and Reynolds (2010), Checkland and Scholes (1999), and Midgley (2000) shows how soft systems thinking helps document personal and collective worldviews in influencing system behaviours. Soft system enquiry supports constructivist epistemology through focusing on the role of both the researcher in the research processes, and the interpretation of empirical observations.

While there are a diversity of ways to understand systems, biophysical constraints are present even in people's interpretation of their own system. More abstractly, boundaries and emergent behaviours can be both objectively identified, or be normative in nature, for example, through enquiring who is and is not involved in benefiting from the system of study. Some principles from the diversity systems thinking literature that draws from both the objective and normative dimensions of systems taken forward in this thesis are:

1. Stocks and flows: A stock is a quantifiable amount of something in the system that can change through time, such as the amount of food available to a family at one point in time. This stock is influenced by inflow and outflow processes; the extent to which the stock can be replenished. For example, the family's food stock might be dependent on the *income* generated to purchase food. If the outflow (food consumption) is faster than available income, then the stock will deplete, leading to hunger.
2. Biophysical limits: These are the limits of a resources in a system, for example water used to irrigate crops. The extent to which humans use biophysical stocks will determine how systems behave. Institutions can monitor these quantifiable constraints, for example through formalising water allocation for individual use.
3. Boundary settings: This is the explicit acknowledgement of what and who is included or excluded from the immediate system of interest. For example, food and

nutrition security could be 'bound' around the household, focusing on the barriers and enablers of families to feed themselves. Alternatively, food and nutrition security could be 'bound' to the national level, where national trends in hunger, obesity, and food availability, access, and stability are used to determine the nation's food security. Issues of ethics, power, and ethics form part of a systems' boundary.

4. Feedbacks: These are the response of changes between different parts of a system Feedback loops are common in systems, were a causal connection between stocks leads to amplifying or reinforcing behaviours. A balancing feedback loop stabilises the system, preserving the behaviour of the system. A positive feedback loop reinforces a particular trends, potentially jeopardising the behaviour of the system.
5. Emergence: This acknowledges the relationships between entities and the overall behaviour of systems as they change through time, noting that system behaviours at a small scale may influence higher scale behaviours.

Soft systems methodologies help focus research on how individual and collective actors in the system choose to behave, and situate their behaviour within boundaries and feedback processes in which they operate. As such, I take from the systems-based Cultural Adaptation Template (CAT) from human ecology (Dyball and Newell, 2015) to draw test the extent to which food discourses can be identified among stakeholders are embedded within a framework concerned with documenting how human and environmental systems interact with each other. This makes human ecology my methodological foundation.

2.5 Human ecology as a systems approach

The human ecology framework developed by Dyball and Newell (2015) offers a tool for identifying discourses in specific contexts and scales. In Chapter 3, I expand on the value of human ecology as a framework that enables the systems analysis of different, and often conflicting, perspectives on specific sustainability challenges. While human ecology has a strong history of blending critical social enquiry with home economics, anthropology, and pedagogy (Dyball, 2017) it has been limited by the lack of coherent methodological guides on 'how' to undertake human ecological analysis. Multiple fields have advanced human ecological enquiry, and over the last decade studies into food systems have taken human ecological approaches (Dyball, 2015; Porter *et al.*, 2014).

Human ecology has a complex history of fluctuating between being a discipline in itself, or being a methodological approach for sustainability research, teaching, and practice. The histories and diversities of human ecology are coherently documented by authors from the United States of America, Australia, Europe, and Southeast Asia (Borden, 2014; Borden, 2017; Rambo, 1983; Rambo and Sajise, 1984; Stokols, 2018). Human ecology is thought to be taught and researched at over 200 universities world-wide, and thus comes with its nuances and often disciplinary

backgrounds[5]. As research approaches for sustainability expand towards the fields of co-creating knowledge and generating new knowledge for complex problems (König, 2018; Miller and Wyborn, 2018), human ecology is placed to advance knowledge and interventions through bringing critical enquiry into questioning how systems operate and the outcomes these systems lead to.

In Table 2, I summarise the institutions and major scholarly contributions from diverse framings of human ecology that have influenced my theoretical approach. Throughout my doctoral candidature, I was exposed to the institutions in Table 2 through conferences or literature. The scholarly output from these institutions influenced how I conceptualise human ecology as a global methodology for understand systems behaviour. While I concentrate throughout the thesis on empirically testing and advancing a system-based human ecology framework as per Dyball and Newell (2015), the different institutions below provided conceptual grounding on human ecology, food systems research, and relevant social science research methods.

Table 2: Human ecology institutions relevant to my methodological approach

Institution	Key elements of their human ecology approach	Example publications
The Australian National University, Australia	Rooted in the urban ecology studies of Stephen Boyden in the 1980s, and advanced through a strong pedagogical and research program. Human ecology conceptualised as a methodology, enabling students and researchers to advance studies into human-environment relations in a number of different fields.	Boyden (1992); Boyden (2001); Boyden (2004); Boyden (2016), Dyball (2010), van Kerkhoff (2014), Brown *et al.* (2010)
College of the Atlantic, United States of America	Largely pedagogical, enabling students to develop critical enquiry into the role of society within environmental limits.	Borden (2014); Borden (2017)
University of California, Irvine, United States of America	Social ecology is the technical term they used, yet Stokols (2018) draws multiple similarities between human ecology and social ecology. The focus here is on multi-scale interactions between human and environmental systems.	Stokols (2018)
University of the Philippines, Los Baños, the Philippines	A strong pedagogical program, with the largest number of graduates in Southeast Asia. The research has focused on community development and nutrition, with a strong home economics background.	Rambo (1983); Rambo and Sajise (1984); Sajise *et al.* (1985)
University of Gothenburg, Sweden	Pedagogical and research focused, with particular attention to transdisciplinary methods and the study of urban-rural linkages in food systems.	Olsson *et al.* (2016); Olsson (2018); Polk (2015); Westberg and Polk (2016), Polk and Bruckmeier (2005)
Arizona State University, United States of America	Pedagogical and research output, with a focus on transdisciplinary methodology development	Lang *et al.* (2017); Wiek and Iwaniec (2014); Wiek and Lang (2016); Wiek *et al.* (2012)

[5] The Society for Human Ecology has a general database of universities involved in teaching and researching human ecology. See: https://societyforhumanecology.org/human-ecology-programs-and-institutions/

Leuphana University, Germany	While the school aligns with socio-ecological research, the transdisciplinary theory research output draws heavily from human ecological foundations, notably Meadows' leverage points concepts.	Abson *et al.* (2017); Caniglia *et al.* (2017); Lang *et al.* (2012); Lang *et al.* (2017); Leventon *et al.* (2016); Velten *et al.* (2015)

Human ecology, to my personal scholarly approach, is a foundational heuristic tool to understanding human thinking and practice in the context of environmental change. I developed this methodological foundation through my undergraduate training in an innovative Bachelor of Interdisciplinary Studies (Sustainability), and a subsequent Master of Environment (Research) at the Australian National University. In both degrees, I was exposed to the thinking and practice of human ecological thinking as defined by scholars from the university such as Brown *et al.* (2010), Van Kerkhoff (van Kerkhoff, 2014; van Kerkhoff and Lebel, 2006), Wyborn (2015), Carpenter (2003), Dyball (2010), Dixon (1999). Beyond their scholarship, I developed an understanding of how soft systems methodologies were useful for critiquing sustainability problems, based on the work of major systems thinkers (Checkland and Scholes, 1999; Midgley, 2000; Ulrich and Reynolds, 2010). These foundations enabled me to approach my research and professional careers with a set of methodological tools for understanding the ethical and environmental concerns within sustainability problems. Building from these foundations, I sought in this thesis to explore how a particular systems-based framework from the field of human ecology, the one developed by Dyball and Newell (2015), could be applied and integrated with social science methods and literature.

Drawing from systems dynamics concepts, Dyball and Newell (2015) proposed a framework (Figure 3), building from Meadows (2008) transferable across scales and contexts that focuses on four major sustainability variables: ecosystems, institutions, human wellbeing, and human belief systems. The framework deliberately constrains itself to the consideration of a limited number of key interacting variables, introduced within the context of food systems literature in Chapter 3. The four general human ecology framework variables are:

- *State of discourses:* This refers to the collective ideas in individuals or groups that influence action. Discourses may not be shared equally (Dryzek, 2007), but the framework draws attention to those that are dominant and most responsible for a system's behaviour. At the same time, the framework can identify alternate discourses that are currently marginalised or oppressed but which, if empowered, could set different goals for the system.
- *State of institutions:* This represents the dominant social institutions that the community has established to govern their collective behaviour. These are the formal and informal rules and institutions that facilitate a community's actions. Formal institutional rules manifest as policy instruments, such as taxes, regulations, and education programs. Informal institutional rules are those tacit regulations that influence what a community judges to be appropriate conduct in the circumstances (Fischer *et al.*, 2012).

- *State of ecosystem:* This includes both the natural environment and anthropogenically constructed artefacts, such as agricultural landscapes, buildings, roads, and vehicles.
- *State of human wellbeing:* This captures all physical and psychosocial aspects of what it means to live well. This includes indicators of good health, such as adequate nutrition.

The human ecology framework draws attention to core variables that may be common between individuals or groups with competing belief systems and discourses. The visual representation of the framework and associated systemic design is presented in Figure 2 as the human ecology Cultural Adaptation Template (Dyball and Newell, 2015). The framework variables interact with each other through processes that feedback to constrain each variable's behaviour, the interactions represented in the framework by arrows. Each interaction or feedback process can have amplifying (+ sign) or balancing (- sign) impacts on other variables. Links 1, 3, and 5 represent individual and collective activity that function to change the quantity or extent of the variables to which they point. Links 2, 4, and 6 are observation processes whereby the individual or community receives signals informing them about the change in the quantity or extent of affected variables. This may create learning and adaptive change in the dominant discourse, which then would feed back to manifest as new collective action and drivers on the affected variables.

While many systems frameworks often lead to highly complex maps trying to capture multiple variables and scales at the same time, the explicit purpose of human ecology as used in this thesis is to embrace complexity while using diagrams to organise how a particular problem, in my case food and nutrition security, is understood by different food system actors in Southeast Asia and the Philippines. The use of such visual processes and tools enable different stakeholders and participants in research processes to work towards building a shared language and understanding of problems (Newell and Siri, 2016). As a framework designed to enable transdisciplinary enquiry, human ecology offers a chance to practically explore understandings of a problem among people who are intending to collaborate on common issues, but who come from diverse cultural or sectorial backgrounds (Brown *et al.*, 2010). I tested this viability of the framework as a tool for identifying food and nutrition security in a collaborative setting (Chapter 5), and within the realm of applied qualitative field work with smallholder farmers (Chapters 6 and 7).

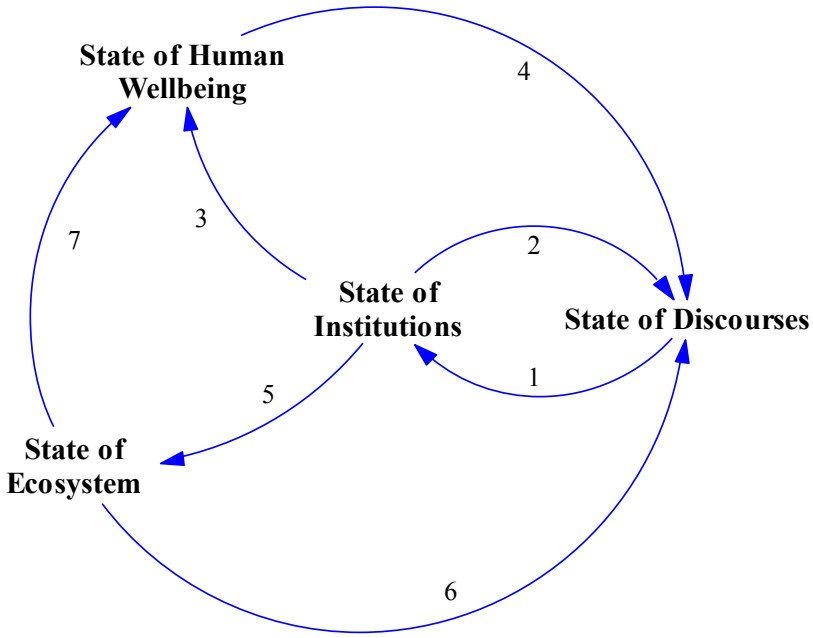


Figure 2: The human ecology framework, adapted from Dyball and Newell (2015). The numbered arrows are explained below.

Within the framework, a series of feedback processes emerge. These can be positive or negative depending on how the framework is applied to literature (as is done in Chapter 3 and 4), or to empirical qualitative data (as is done in Chapter 5, 6, and 7). The summary explanation of the links is as follows:

1. The influence that a dominant discourse has on generating formal and informal decisions amongst individuals or institutions. This includes planning and goal setting resulting in the design and implementation of policies to promote the dominant discourses in society.
2. As formal and informal institutions lead people to behave in particular ways, they will either reinforce or change the dominant discourse. Dominant discourses may change or resist change, as other institutions might reinforce it. If they were changed, they would influence the formation of new institutions to reflect the new discourse.
3. This link shows the implications of institutional decisions on an individual or a community's physical and psychological wellbeing.
4. As communities and individuals change based on institutional activities, dominant discourses may shift, eventually creating new institutional interventions. As with Link 2, these observations may challenge or reinforce core values, depending on circumstances.
5. This includes collective activities promoted or enabled by dominant social institutions that directly affect the environment.
6. As ecosystems change based on formal and informal institutional activities, new discourses may emerge or dominant discourses perpetuated.

7. Ecosystems are affected by policies and human behaviour, and as ecosystems change they directly affect human health and wellbeing.

I use the framework conceptually to compare and contrast food discourses (Chapter 3), and to explore the historical and political nature of food systems in the Philippines (Chapter 4). In Chapter 5, I use the framework to analyse various systems diagrams produced by research and policy experts to identify their discourses that inform their approach to improving food and nutrition security. Chapters 6 and 7 present the application of the framework to semi-structured interview data collected from smallholder farmers in Leyte, the Philippines, explained below. The resulting diagrams from applying the framework act as heuristic devices to simply and clearly reveal differences in how the situation is understood and to 'see where each other is coming from'. These visual models provide a crucial first step for advancing research and policy that seeks to be co-productive and focused on ongoing knowledge exchange between stakeholders. The diagrams emerging from stakeholders or data analysis provide a 'snapshot in time', capturing perceptions of the state of the system at a given moment. However, the system is dynamic and interacts and adapts across time, and so it is the patterns or trajectory of change that is important. For example, some farms might be experiencing highly productive seasons, but sudden shocks, such as severe flooding, may affect the behaviour of the system. As such, the visual outputs are not 'right or wrong', but rather they show how a particular situation is framed, providing a platform for critically examining how and why such framing exists.

2.6 Regional context of this research

The complexity of global food systems requires the identification of boundaries for conducting empirical research. Boundary setting is core to any systems thinking study, as it enables researchers to frame what is 'in' and what is 'out' from the system of interest as a way of overcoming the overwhelming complexity of problems (Newell and Proust, 2018). Setting boundaries around a particular system enables researchers to provide detailed analysis on how that system behaves. Boundary setting is also a critically reflexive process, where researchers openly acknowledge what they seek to analyse and what they acknowledge but do not include in the analysis. However, such a bounded system needs to be able to produce transferable knowledge that is applicable to other case studies and sustainability contexts (Adler *et al.*, 2018; Magliocca *et al.*, 2018). In food systems, a focus on regions enables studies to understand how locally specific activities are influenced by broader processes (Ingram *et al.*, 2010). This thesis is bound to Southeast Asian regional research agendas focused on food systems studies, with an analysis of the challenges of the agenda presented in Chapter 5. To examine a detailed case study, I have chosen to bound the system to cash commodity production systems in the Philippines (Chapter 4), as they remain the major source of livelihood for rural smallholder farmers. Chapters 6 and 7 focus on a coconut producing system in Leyte and the nature of food discourses in that specific context.

The Philippines provides a Southeast Asian country context with a large rural population involved in agriculture who remain food insecure and with poor developmental status (UNDP,

2013). In a country of over 7,000 islands, over half of the 100 million people depend directly or indirectly on income generated through the production of key agricultural commodities (UNDP, 2013). Total agricultural land is 125,000 square kilometres, just under half the total available land. Agriculture contributes between 12-20% of total gross domestic product (Cororaton and Corong, 2009). Climate change is manifested through intense weather events and unpredictable seasonal forecasts (de Leon and Pittock, 2016). Agricultural policies support the production of cash commodities for domestic and global markets (see Figure 3), and farmers are largely dependent on this income for their household's food security (Davidson, 2016; UNDP, 2013; Zamora *et al.*, 2013).

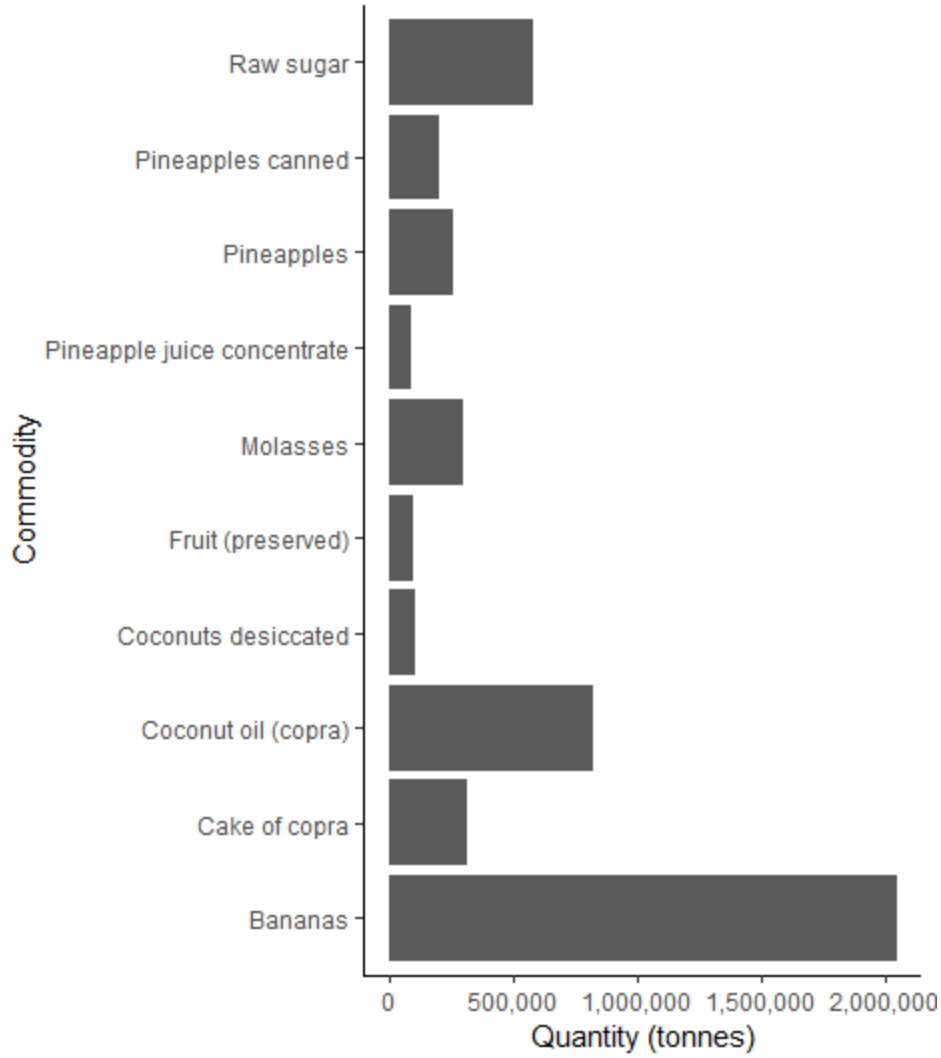


Figure 3: Top ten export commodities in the Philippines (FAO, 2011)

Philippine agricultural households are highly food insecure, often facing 'hungry seasons' when food cannot be harvested, commodity prices are low, or climate shocks destroy crops (Reyes *et al.*, 2012). The Philippines government contends that participation in policy and access to food should be essential rights among smallholder farmers (Government of the Philippines, 1992; Government of the Philippines, 2014), yet pervasive inequality and poverty remain core challenges. Despite

advances towards reducing malnutrition and rapidly industrialising the food system, the national Philippines food system has failed to deliver adequate and equitable food and nutrition security to the population (Philippine Statistic Authority, 2013). The interaction of market driven policy, high biodiversity context, and rapidly changing environment make the Philippines a salient case study to explore how food security and food sovereignty are embodied in food systems. The focus on smallholder farmers in the Philippines allows me to link how the dominant food producers in the country conceptualise their food security, and how institutions inhibit or enable different discourses from being enacted.

Early on in the framing stages of this study, I visited the University of the Philippines Los Baños (UPLB) College of Human Ecology. This institution has over 40 years' experience in teaching human ecology, with a strong focus on community and nutrition as drivers of human wellbeing. UPLB also has a strong history of agricultural and forestry sciences, and housing the International Rice Research Institute and offices for World Fish. The university is geographically located near the Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development, the main funder of national agricultural research within the Philippines. The long history of these institutions has made Los Baños a highly vibrant and intellectual rural town in the Philippines, with extensive knowledge outputs targeted at improving the productivity of Philippine agricultural and aquatic systems. Another agency housed within the UPLB campus is the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA). As a boundary organisation[6], SEARCA is able to link agricultural researchers with farmers and policy makers, with the ultimate purpose of improving farmer wellbeing and agricultural productivity. SEARCA is well established as a reputable research centre, providing academic and policy outputs on agronomy and forestry over the last 50 years (Depositario *et al.*, 2015; Depositario and Saguiguit, 2014). SEARCA continues to advance agricultural sustainability knowledge, and in 2014 launched an ambitious plan to break traditional disciplinary approaches to agricultural research and move towards transdisciplinary and systems-based research approaches. This plan was labelled the Inclusive and Sustainable Agricultural and Rural Development Projects (ISARD), and sought to support Philippine and Southeast Asian universities and policy makers in co-designing agricultural activities that included farmer concerns, increased the use of systems and participatory approaches, and piloted transitions towards more sustainable agricultural practices in selected regions.

In the scoping phases of this study in 2014, I established networks and links with UPLB and SEARCA to discuss the relevance of human ecology and social science research to the ISARD plan. Using an existing regional agenda provided my ideas contextual legitimacy, allowing me to ground the theoretical and field work approaches with ongoing or new initiatives being developed by

[6] A boundary organisation is commonly defined as organisations that facilitate knowledge flows between different actors, who may be from different sectors. Boundary organisations need to communicate, translate, and mediate knowledge adequately between actors (Cash *et al.*, 2003).

SEARCA. Given that ISARD was a new initiative, we agreed that the value of my research to the university and SEARCA would lie in testing the frameworks and ideas, and identifying the underlying drivers of agricultural practices in a rural Philippine context. The selected case study for this study, Leyte, was discussed with SEARCA as salient to future agricultural development activities. While previous work by other researchers has been conducted in Leyte in the forestry, biodiversity, and soil management sectors (Baynes *et al.*, 2011a; Baynes *et al.*, 2011b; Cedamon *et al.*, 2011; Groetschel, 2001; Navarrete *et al.*, 2013; Nguyen *et al.*, 2012; Pasa, 2011), there had been less exploration of smallholders' beliefs of what they perceived as adequate strategies to improve food and nutrition security. Through discussing the framework, research approach, and alignment to ISARD's vision of transdisciplinary work, I designed my study to provide new knowledge to Philippine agencies tasked with improving food and nutrition security through their future research investments.

2.6.1 Regional workshop

As part of this research, I led a workshop with ISARD policy makers and researchers from four countries (Cambodia, People's Democratic Republic of Laos, Thailand, and the Philippines) to capture their understandings of food and nutrition security interventions, which I explain in detail in Chapter 5. The workshop with researchers and policy makers was used to identify what they understood as the nature of food insecurity problems, what interventions they thought would improve these problems, and what they saw as the relationship between those involved in creating change. The workshop's aim was to gain insights into the participants' dominant understandings of pertinent issues and key agents involved, not to critique or verify their views. This aim was achieved through using systems diagramming activities to identify framings of improving levels of food and nutrition security in specific contexts. Systems diagrams produced from the workshop enabled the identification of common framings of interventions to food and nutrition security in four country contexts. I use these framings in Chapter 5 to discuss the challenges and opportunities for transdisciplinary research programs, such as the ones led by SEARCA, in Southeast Asia.

Eighteen (18) participants took part in the one day workshop in June 2015, facilitated by staff from the Australian National University and the University of the Philippines, Los Baños. The participants were purposefully selected by the research team and SEARCA as future leaders of the ISARD program and therefore central to the development of transdisciplinary programs in the region. Workshop participants included university researchers and local government representatives from Cambodia, Laos, Thailand, and the Philippines, as this activity was part of the initial phase of the co-design of longer-term transdisciplinary endeavours in the region. Each of the selected countries face major food and nutrition security challenges in urban and rural contexts ranging from food availability (Cambodia and Laos) to nutritional quality of available food (Thailand and Cambodia). The participants are heavily involved in transferring research to applied agriculture contexts, and are highly familiar with their local farming communities and landscapes. The

Philippines group included a mix of researchers and government officials who have been commissioned to collaborate and work on future ISARD projects, and had the highest number of attendance due to logistical feasibility and the context in which SEARCA works in. The Thailand group had researchers who worked actively with the national department of agriculture. Participants from Cambodia and Laos were all researchers involved in extension services with farmers. All participants were expected to develop proposals in their home countries for future funding from SEARCA with explicit transdisciplinary design. The omission of other major food systems actors, such as farmers, non-government organisations, and business, was explicit in the workshop design. This workshop targeted government agencies and researchers that SEARCA seeks as major actors in engaging broader food systems actors. Similar future activities with broader food systems actors remain part of the broader ISARD program. The step by step systems method and guide to the workshop activities is explained in Chapter 5.

2.7 The Philippines and Semi-structured interviews in Leyte

I conducted 39 semi-structured interviews with smallholder farmers to document their food system challenges, guided by the concepted presented in Chapter 1 and the human ecology framework outlined above. The study site justification, interview approach, and coding structure are detailed here. However, due to the nature of the thesis by compilation format, they are covered again in Chapters 6 and 7, which are individual manuscripts submitted to separate journals.

The island of Leyte in the Eastern Visayas region is the eighth largest Philippine island (Figure 4). It is home to 1.7 million people with 55% of household incomes dependent on agriculture or fisheries as the main source of livelihood (Groetschel, 2001). Average yearly family income is USD1,300 and poverty incidence is 47% (PSA, 2009). From a total land area of 800,000 hectares, approximately 10% remains as forest cover, with much old-growth and primary forest replaced by coconut and abaca plantations, grown on relatively flat agricultural land (Mukul *et al.*, 2016). Climatically, the island has a relatively even rainfall distribution throughout the year with annual rainfall totalling approximately 4,000 mm, with a dry season from March to May and wet season October to January, and relatively good soil moisture conditions (Mukul *et al.*, 2016; Navarrete *et al.*, 2013). The island has a long history of settlement and intense land use for forestry and agricultural products dating back to the Spanish colonial era. In Leyte, elite land-owning families established governance structures and laws that enabled them to have tenants in Haciendas (large areas of private land) working in intensive commodity production, notably coconut and copra (Dressler *et al.*, 2016a). Increasing agricultural productivity in key commodities remains a major

development plan for the provincial government (Leyte), as well as municipal (town) and barangays[7] (Inopacan Local Government Unit, 2012).

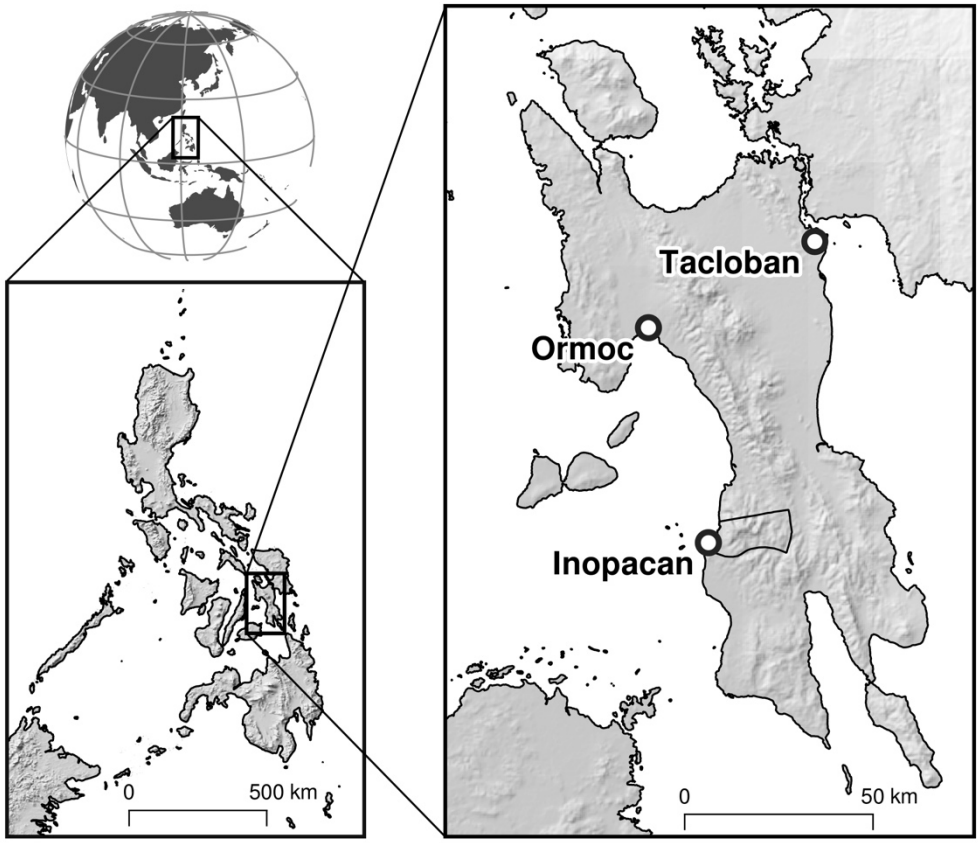


Figure 4: Geographical locations of the Philippines, Leyte, and Inopacan

Inopacan is a town of 20,000 people which lies in south-western Leyte, has a geopolitical area of 9,699 hectares, and a hilly environment with the highest elevation point at 1000 meters (Figure 5). Inopacan is a 4th class municipality, one of the poorest in the Philippines, where the average individual income is of USD585 per year (approximately USD1.6 per day). There are 4,415 households with an average of 4.3 people per household. The landform is predominantly rolling to steep volcanic hills. Soil erosion is a major problem in Inopacan, with approximately 30% of the town's land heavily eroded (Inopacan Local Government Unit, 2012). This is consistent with the broader island of Leyte, which has been severely degraded through decades of intensive land modification (Olabisi, 2011).

The town has 20 barangays, eight of which are coastal, 11 are upland, and 1 is an island. The literacy rate is 89%, and school, health services, and markets are physically accessible for all except the far eastern barangays, where poor road conditions makes transport difficult during heavy rains.

[7] The smallest administrative political unit in the Philippines

Employment is high, with 70% of the population engaged in the labour force. Agriculture is the main economic sector, with coconut being the major cash crop, and other crops such as banana, sweet potato, and cassava intercropped when appropriate. Inopacan has a total agricultural area of 4,107 hectares, of which 3,789 is devoted to planted crops, largely coconuts. Inopacan contributes to Leyte's total coconut output of approximately 200,000 tonnes per year, contributing to the Philippine's status as the world's second largest coconut exporter (Watson *et al.*, 2015).

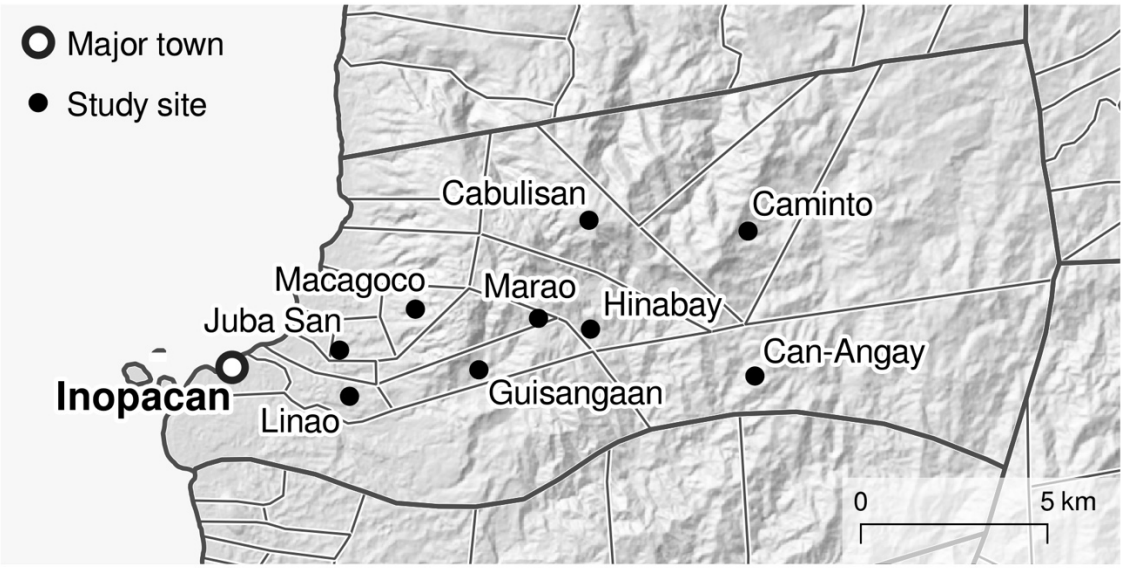


Figure 5: Inopacan barangay distribution and the sites visited for interviews

2.8 Qualitative methods and analysis

Qualitative research enables the study of human perspectives, responses, values, discourses, and overall interactions with environmental, social, and economic systems (Hay, 2008; Richards, 2014). While the researcher may bring a range of theoretical and subject matter expertise, participants of the research process provide contextual nuance of how theories are reflected in practice. Transdisciplinary enquiry is one where knowledge beyond academia is used to inform how questions are asked and data is interpreted during the research process (Brown *et al.*, 2010). Part of this transdisciplinary enquiry was my interaction with SEARCA over a 4 year period, where I spent periods of work in their offices either conducting a workshop, participating in project design meetings, or debating food systems research in Southeast Asia.

The semi-structure interview protocol (Appendix 3) focused on themes including socio-economic and demographic profile of farmers, experiences and definitions of food security, the visions of what they perceived as a food secure food system, experiences of environmental change, and interactions with government and training bodies. Food security in the interview guide was framed at the household scale, as smallholders in the Philippines remain largely dependent on subsistence agriculture for their immediate food security. Semi-structured interviews allowed a fluid conversation to be carried out with smallholder farmers in the field. The interview protocol provided

a heuristic device for the researcher to guide conversation along the major themes, with farmers talking openly about their experiences.

I conducted a total of 39 interviews across nine barangays over a three-week period in July 2015 (see Table 3). Interviews lasted between 20-70 minutes, and were often conducted at farmers' homes or in the barangay hall. I formally carried out courtesy calls and often lunches with barangay captains to inform them of the project and how it linked with Philippines research initiatives in agricultural research, notably through SEARCA's transdisciplinary research plan. Interviewees were informed of the research project and verbal consent was sought due to cultural appropriateness, and they were offered to withdraw from the process at any point. Interviews were conducted in the local Visayan dialect with the assistance of an interpreter with proficient English, facilitated through the university networks. Interviews were recorded with verbal consent and transcribed on the day immediately after the interviews, and organised along the lines of the interview protocol. These were then discussed with the interpreter to ensure the right interpretation was captured in the transcripts, as much as was possible. Furthermore, a report back visit was conducted in January 2017 to exchange initial findings and progress on food systems projects being undertaken between myself researcher and partner universities in the Philippines. The audience for the report back included farmers from upland villages, extension officers, university researchers, and local government unit members. This study was cleared by the ANU Human Research Ethics Committee, and information and consent sheets were updated as the research project evolved (Appendix 1).

Table 3: Overview of smallholders interviewed

Barangay	Age range	Number of males interviewed	Number of females interviewed	Farm size range	Number of farmers with additional non-farm livelihood
Can-angay	40-61	1	3	1 hectare	None
Cabulisan	45-67	2	2	1-8 hectares	1 male driver
Caminto	40-74	3	2	1-5 hectares	1 female care worker
Guinsanga-an	47-65	3	2	0.25-2 hectares	1 female occasional coconut wine maker
Hinabay	49-65	2	2	1	3 farm workers, 1 male owns a shop
Jabulisan	36-62	2	2	0.5-2 hectares	1 male driver, 1 female farm worker
Linao	43-61	1	4	0.3 - 4	1 female on honorarium from past council work
Macagoco	53-77	0	3	0.5 – 1	None
Marao	36-79	3	2	0.25 - 5	One family member makes wine

After transcription, data was imported into the analytical software MAXQDA. Thematic coding was conducted using both inductive and deductive techniques (Braun and Clarke, 2008; Ryan and Bernard, 2003; Saldaña, 2015).

The coding structure for this thesis followed a three step process:

1. Deductive codes were informed by specific topics in food systems, food security, and food sovereignty literature. The orienting concepts presented in Chapter 1 (market food security, food sovereignty, food systems), and literature from Chapters 3 and 4, provided a range of initial codes to assign to different quotes. Inductive codes were created to show specific issues that emerged from the interviews. For example, codes relating to agroforestry and intercropping vegetables, originally not part of the literature themes, emerged as core drivers of food security (see this example in Chapter 7).
2. A second round of coding was conducted to amalgamate codes into nodes, which allow for the categorisation of codes into individual food literature variables. This allowed specific codes, such as ‘access to fertilizers’ to form part of higher level codes to provide organisational structure, for example ‘support for agricultural practices’.

3. A third round of coding was conducted following the human ecology framework, where nodes were situated into the four meta variables: state of ecosystems, state of human wellbeing, state of institutions, and state of discourses.

After the coding was completed, a series of code relation tables were produced to show the links between specific codes and nodes. The data relationships were interpreted analytically using the four variables in the human ecology framework (Davila and Dyball, 2018; Dyball and Newell, 2015). Throughout the thesis, the human ecology framework is used analytically to synthesise findings and discuss emergent themes from the interviews. The diagrams provide heuristic devises for understanding how participants conceptualise issues of food and nutrition security. The diagrams are not used to articulate whether participants are 'right or wrong'; rather they are used to show how issues are conceptualised at one point in time and how they align with broader systems and human ecology analysis developed in this thesis.

2.9 Conclusion

This chapter has presented the methodology grounding, the question design, and analytical approach to the literature and empirical material in this thesis. I presented a relational ontological context for conceptualising how meaning and context inform each other, and how this is salient to studies into the interactions between food sovereignty and food security discourse. Epistemologically, my approach to understanding knowledge was driven by the focus on participant's experiences and role in creating knowledge throughout the research process. This knowledge is interpreted through constructivist epistemology, where I frame people's responses to interview questions as based on their experiences in food activities. Based on these ontological and epistemological foundations, I presented soft systems thinking as a theoretical perspective that allows people's perspectives to be situated within bounded human and ecological processes. Soft systems theory enables me to explore how discourses exist in a specific context and how they influence every day activities in food policy and research. As a systems-based methodology, I ground human ecology as a suitable framework for discovering how discourses exist among specific actors involved in food systems research and practice in Southeast Asia and the Philippines. To explore the role of different actors in food systems, I defined policy makers and researchers tasked in developing transdisciplinary food systems research as major players in advancing systems knowledge in the region. Parallel to them, smallholder farmers continue to be largely marginalised from food research and policy developments, yet remain critical in providing food for growing populations. A focus on Philippine smallholder food production enabled me to explore how smallholders frame their food systems, and what discourses exist in their responses. To analyse the empirical data, I sought to discover how human ecology interprets current literature themes in food systems and discourse literature. This analysis is presented next in Chapter 3.

Chapter 3: Food systems and human ecology

Full reference: **Davila, F.** and Dyball, R., 2018. 'Food Systems and Human Ecology: An Overview. In Koenig, A. (ed) *Sustainability Science: Key issues*, Routledge, London, pp. 183-210.

Status: Published in 2018

As per Table 1, Section 1.6 of this thesis, this manuscript contributes to the thesis research question: *How does the human ecology framework help guide analysis of food system discourses?* Within this chapter, I demonstrate how human ecology helps in identifying the influence that different discourses have on perspectives and solutions for food system challenges. From this identification, I propose a future food systems research agenda that acknowledges and integrates governance and politics.

3.1 Introduction

A major sustainability challenge is to feed the world's population whilst reducing environmental impacts, narrowing inequities in food access, and meeting global nutritional needs (Ingram, 2011a; Lawrence *et al.*, 2010). If this challenge is to be met, processes operating between key interacting factors must be successfully managed. These factors include the social and economic (Carolan, 2016; Dethier and Effenberger, 2012) environmental (Vermeulen et al., 2012), and health and wellbeing (Friel and Ford, 2015) and occur across the food chain from production, manufacture and processing, to distribution, retail, and end consumption. Because these factors dynamically interact to drive changes in each other, it is preferable to think of food systems rather than chains (Ericksen, 2008b; Ingram, 2011b). The goal of a food system is, or should be, to regularly and reliably make appropriate food available at a specific scale, be it a household, town, or nation. We add the words 'should be' to flag that the purpose or goal of food systems is actually contested, as discussed later.

Current food systems are failing many people and communities around the globe. A billion people cannot regularly and reliably obtain minimally adequate calorific food intake, and 2 billion more do not achieve adequate nutrient consumption needed for good health. Another 2 billion suffer from over consumption of inappropriate foodstuffs and suffer from a range of health issues associated with being overweight or obese, often also in conjunction with inadequate nutrient intake (Ingram et al., 2016; Westengen & Banik, 2016; Friel & Ford, 2015). Typically, the solution to poor health and wellbeing outcomes from food system failure has been sought through applied agronomics , aimed at increasing volumes of food produced, in combination with agricultural and trade policies designed to facilitate free markets and trade (Carolan, 2016; Lee, 2012). This approach has been called the 'productionist paradigm'(Lang, 2010; Lang & Heasman, 2004). Not only has the productionist approach failed to meet the challenge of feeding the world's population, but it has also produced social and environmental ills of its own. These negative outcomes range from the poor incomes and low social status of many of the world's food producers and rural communities to the fact that agriculture globally is one of the major drivers of biodiversity loss, nutrient loss and land and water degradation, and climate change (Carolan, 2016; Deutsch *et al.*, 2013; Ericksen, 2008a; Ingram, 2011a) Policy and decision making at all scales from local, regional, national, and international levels is urgently needed to address these critical yet persistent health and wellbeing effects of inadequate food system outcomes and to halt and reverse associated environmental damage.

Understanding the behaviour of food systems is further confounded by the systemic uncertainty brought by the knowledge, beliefs, and judgements of people. At the level of individual households and consumers, people's values and belief systems influence how they produce, purchase, and consume food, including what they see as a 'normal' expectation of comfort, choice, and cost of foodstuffs year round. This expectation of entitlement, at least in affluent nations, demands that food systems make a wide range of foodstuffs available irrespective of the realities of local or regional

seasonal agricultural production (Clapp, 2015; Porter *et al.*, 2014). Satisfying this demand requires constant stocking of foodstuffs sourced from highly flexible globally distributed inventories and is inherently energy intensive, wasteful, and uncaring of justice and sustainability issues (Christensen, 2015).

At the level of governments and private corporations, dominant beliefs in, for example, what is seen as the role of business and industry, technology, free markets, and trade influence how food systems are conceived as optimally operating (Westengen & Banik, 2016; Barling & Duncan, 2015). Decision makers, and those with the power to influence them, strive to create legal, institutional, and market mechanisms that reflect and give effect to these priorities. Furthermore, many global agribusinesses activities sit beyond the reach of any sovereign jurisdiction and are subject to little accountability, other than the corporation's own sense of responsibility (Christensen, 2015; Kalfagianni, 2015). These myriad and often-conflicting sets of priorities, beliefs, and value-judgements held by various parties with differing power and economic agency interact across and between scales (Berbés-Blázquez *et al.*, 2016). The ultimate result are massive inequities in the availability of food to feed the world's population, and myriad environmental and social justice problems, generating a global 'wicked problem' (Brown et al., 2010).

Wicked problems have endemic features that limit the capacity of conventional science, operating as 'problem solving', to contribute towards their resolution. Wicked problems typically are not so much 'solved' as rendered 'manageable' or 'acceptable' to those engaging with them. To address wicked problems we need novel ways of framing and designing interventions that deal with social and environmental domains and identify the root causes of sustainability problems (Abson *et al.*, 2017; Lövbrand *et al.*, 2015). To address them, we need a form of science that is capable of handling both quantitative and qualitative variables in the same frame, as people's beliefs or opinions about the problem are as important as its factual elements.

We need a science that does not eschew normative judgements about how just or acceptable the situation is: that is comfortable with defending what should be. And we need a science that embraces the knowledge and values of the broader community that are affected by problem and whose opinion about proposed interventions must be genuinely taken into account. Such a science would be fundamentally democratic and synthetic. Funtowicz and Ravetz (1991) coined the term 'post normal science' for the form of science need to help inform decision making in these circumstances where 'facts are uncertain, values in dispute, stakes are high, and decisions are urgent' (Funtowicz & Ravetz, 1993, p. 744). They also coined the term 'extended peer community' for the class of affected stakeholders who must be politically engaged in the co-production of the knowledge needed to inform mutually acceptable and prudential policy directions. With high and contested decision stakes, inherent uncertainty, and significant ethical dimensions and political power imbalances, the challenge of justly and sustainably feeding the world's population sits squarely in the domain of interdisciplinary post normal science. What is needed to operationalize rigorous post normal science for understanding global food systems is a conceptual framework that enables

comprehensive understanding of the nature of the problem as a whole. Such framework needs to be logical to all relevant actors, preserve policy relevance, advocate for stakeholder inclusion, and inform decision making at the level of the specific local contexts where the problems manifest (Ericksen, 2008; Ravetz, 2006; Foran et al., 2014; Wittman et al., 2016; IPES Food, 2015).

Here we present the systems thinking framework developed in Understanding Human Ecology (Dyball & Newell, 2015) as a framework for grounding a post normal scientific understanding of sustainable food systems. This framework allows us to analyse the influence that underlying beliefs have on a system's behaviour and outcomes and to compare two or more systems in terms of their common structure. Applying human ecology to food systems allows us to capture how different dominant discourses and degrees of social power influence system outcomes and affect social arrangements, human wellbeing, and ecosystem health. This in turn draws attention to the need to challenge and change these belief systems if we are to generate new food systems with different structures and so with more just and sustainable outcomes.

Within this context, we have two aims for this chapter:

1. To demonstrate how human ecology helps in identifying the influence that different discourses have on perspectives and solutions for food system challenges,
2. From this identification, to propose a future food systems research agenda that acknowledges and integrates governance and politics, including issues of power.

We first present the human ecology framework and apply it to a food system problem space. We then provide an overview of two competing sets of food discourses and compare how they create differing meaning, judgement, and behaviour to influence food systems. The overwhelmingly dominant discourse we address is that of 'food security', with its conventional definition of being the situation 'when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life' (FAO, 2015). With the application of the human ecology framework, we will show how this discourse privileges food systems that can be structured to be neither just nor sustainable and liable to not deliver the expected health outcomes to consumers. We contrast this with a discourse of 'food sovereignty', which is focused on national and community-level rights and inclusion in food decision-making processes (Wittman et al., 2010a; Wittman et al., 2011). Food sovereignty remains more marginalised that food security as a discourse, yet we argue that if offers a way of re-conceptualizing the goal of food systems, specifically to give voice to the dimensions of justice and sustainability that the food security discourse disempowers. We then organize themes from literature that studies food issues and solutions in relation to the ecosystems, human wellbeing, and institution variables in the framework. We conclude the chapter by arguing that food systems can benefit from social science work that looks at food governance and politics, as they are driven by the discourses analysed throughout the chapter.

3.2 The theory: human ecology framework

We employ a dynamic systems framework drawn from human ecology as it allows us to holistically and comprehensively understand the behaviour of complex human–environment systems. Such an approach draws specific attention to the influence of the dominant discourses driving change in such systems. Ostrom (2010) highlights the crucial role that frameworks play in generating meaning and understanding of complex situations. Frameworks 'organize diagnostic and prescriptive inquiry and provide a general list of variables that should be used in analysis. The elements contained in the framework help the analyst identify the central questions that need to be addressed' (Ostrom, 2010, p. 5). The human ecology framework helps reveal what community and stakeholders seek to include and what to exclude in the problem situation under analysis. It can then promote debate about what the problem is but also what should be done about it through interpreting the role of different discourses.

The framework deliberately constrains itself to the consideration of a limited number of key interacting variables. This is crucial to enable the participating peer community to not get lost in the complex detail of the problem situation, but to illustrate the 'non-linear effects caused by feedback and accumulation, and focus on the endogenous dynamics generated within well-defined boundaries' (Newell & Siri, 2016, p. 93). The resulting diagrams are heuristic devices to simply and clearly reveal different mental models of how the situation is understood and to 'see where each other is coming from': a crucial first step to collaboration and co-production of knowledge and policy. The models facilitate discussion of 'dynamic hypothesis', defined as 'a causal structure that is proposed to explain the behaviour of a system in terms of endogenously generated feedback effects' (Dyball & Newell, 2015, p. 66). Consequently they guide democratic and collective debate of the 'what about/what if' questions asked by post normal science (Ravetz, 1997).

'Variables' are the objects (understood to include non-physical objects such as a 'discourse') that the particular problem situation is composed of, with the definitional meaning that those objects can be present in greater or lesser amounts. In food systems it is, for example, the amount of food that a person has access to that might be one variable of concern. The amount of a variable changes dynamically over time, so we might be concerned not just that a person has sufficient food on a given day, but whether the pattern of change in the amount they have over time is regularly and reliably sufficient or periodically insufficient. Our focus then would turn to the processes that are changing those volumes over time to see what intervention might remove the problem of periodic insufficient supply. The diagrams illustrated here are then 'snapshots in time' capturing the state of the system, as evidenced by the amount or extent of its variables, at a given moment. However, the system is dynamic and interacts and adapts across time, and so it is the patterns or trajectory of change that is important. Too much focus on the state of the system, such as the number of fish at a given time, can be deceptive. If the rate of fishing exceeds the rate of replenishment through breeding, then the fishery is in an unsustainable downward trajectory towards collapse even if its population appears inexhaustibly large.

Figure 6 presents a human ecology framework based on Dyball and Newell (2015). The four variables shown are the fewest number of the most abstract and generic categories of variables (including immaterial things like discourses) that require consideration in any human–environment situation.

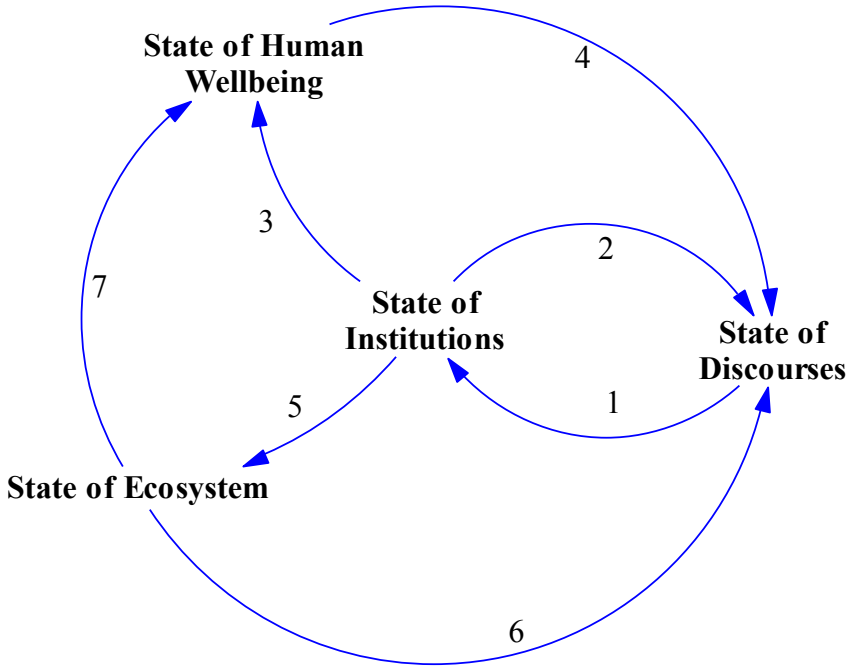


Figure 6: The four generic labels for variables in human–environment systems and feedback

These variables are labelled as follows:

3. State of Ecosystem: the quantity or extent of a variable that indicates the state of the environment at any point in time. At certain levels some people may experience the amount of this variable as a problem. For example, the amount of some particulate may accumulate in the atmosphere to a level where it is considered a pollutant. Equally, the problem could emerge if the level of the variable deteriorated below a certain threshold, such as the decline in terrestrial stocks of available phosphorus. A provisional list of the levels key variables of concern, and their respective safe operating zones, are offered in planetary boundaries (Rockstrom et al., 2009).
4. State of Human Wellbeing: the quantity or extent of a variable that indicates the state of an individual or community's physical and psycho-social wellbeing. The level of these indicators would allow judgements as to whether the individual or group's standard of living was sufficiently above some threshold that they could be said to be living well. A provisional list of universal human health needs is offered by Boyden (2016). This list acknowledges that there are both bio-physical subsistence thresholds common to all

humans, such as minimal nutrient intake for good health, and culturally relative standards of adequacy unique to a particularly society. For example, there is no biological requirement to wash or have a number of different clothes suitable for different occasions, but in many societies it would be socially unacceptable not to. Furthermore, although these variables may have minimal thresholds, they do not necessarily have obvious maximum limits, such as the point at which the community has too much love. Boyden reminds us that living well is driven both by the absence of stressors, such as the absence of sources of fear in our community, and the presence of mitigating factors, such as the presence of convivial social networks (Boyden, 2004, pp. 67–68).

5. State of Institutions: the quantity or extent of a variable that indicates the state and effectiveness of both formal and informal rules that are structuring the interactions and the collective behaviour of the community in question. An institution is a persistent, reasonably predictable arrangement, law, process, custom or organisation structuring aspects of the political, social, cultural or economic transactions and relationships in a society. Institutions allow organized and collective efforts toward common concerns and the achievement of social goals. Although by definition persistent, institutions constantly evolve (Dovers, 2001)We note that institutions at different levels can enable collective endeavor towards desirable social goals, but also blind or obstruct reform (Fischer et al., 2012).
6. State of Discourse: a discourse is a set of ideas that stimulates human activity and collective action (Dryzek, 1997). State of discourse is represented by indicators that capture how the situation is being framed and what collective meaning is interpreted from a given set of signals about the state of the situation. Discourses influence the behaviour and goals of systems, largely because they establish institutions that are intended to give effect to whatever collective response they promote as prudent (‘wise’) in the circumstances. Not all individuals in a society share the same discourse, and any two people may have a greater or lesser degree of a ‘shared conceptual repertoire’, which can be a major obstacle to collaboration (Dyball & Newell, 2015, p. 53). This lack of a shared conceptual repertoire is almost inevitable when an extended peer community that includes scientists, policy makers, extension officers, and farmers undertake to collaborate on reducing food insecurity. It is another reason the framework uses only a few, simply labelled, variables and processes, because these generic and basic concepts are more likely to have shared understanding and meaning. However, the ability to frame the discourse at a national or international level is a crucial dimension of social power (Lakoff, 2004). For many complex problems the enduring solution lies in recognizing and subverting the power of the dominant discourse so as to reframe the discourse and restructure the system (Meadows, 2008).

These variables interact with each other through processes that feedback to constrain each other's behaviour, represented in the framework by arrows. Links one, three, and five represent individual and collective activity that function to change the quantity or extent of the variables to which they point. Links two, four, and six are observation processes whereby the individual or community receives signals informing them about the change in the quantity or extent of affected variables. This may cause learning and adaptive change in the dominant discourse, which then would feed back to manifest as new collective action and drivers on the affected variables. Entrenched power and policy resistance may mean the signals are too weak to change the discourse. Link seven is the only process link that is not mediated through social institutions. It represents the direct effect of changes to environmental variables on human health and wellbeing. It can be thought of as the 'co-benefits' (or burdens) that action to change the state of the environment has on changing the state of human health and wellbeing. An example would be the co-benefit of protecting riverine habitat for endangered fish on the quality of water drawn from that river for human consumption.

The framework promotes understanding of human–environment interactions as primarily feedback systems in which the overall behaviour of the whole emerges from the interactions between its parts. This is important for decision making, as one cannot understand the behaviour of such systems by studying the behaviour of the parts taken in isolation. It follows that any policy intervention design to affect a part of such a system in isolation of the whole is liable to fail. We have to study the system as a whole. However, we need to do so in such a way as to not be overwhelmed by its complexity and retreat to ineffective partial approaches. The framework provides a means of understanding human–environment systems comprehensively. By promoting 'feedback guided analysis' we can reveal the way that the systemic structure of problematic systems is acting to constrain how the parts of the system drive change over time. This then allows us to consider what the case is and what should be the case for any human–environment situation and to suggest points of successful and lasting intervention by changing the structure of the situation and consequently its behaviour.

In this view the meaning of the word sustainability becomes a description of the characteristic rate of change in the value of key indicator variables over time, such that the variables are not accumulating (or declining) towards their relevant safe thresholds. The three principles of sustainability set out by Dyball & Newell (2015) are:

1. A process that consumes a non-renewable resource is sustainable as long as the rate at which it uses that resource does not exceed the rate at which a renewable resource (used sustainably) is substituted;
2. A process that consumes a renewable resource is sustainable as long as the rate at which it uses that resource does not exceed the rate of regeneration of the resource;
3. A process is sustainable as long as the rate at which it generates a pollutant does not exceed the rate at which that pollutant can be recycled, absorbed, or rendered harmless in the environment. (Dyball & Newell, 2015, p. 94)

The principles of justice enshrined in human ecology (Christensen, 2015) demand that these principles are met in such a way that all members of the community achieve a level of consumption that enables at least a minimally dignified level of health and wellbeing.

3.2.1 Summary of the value of a human ecology framework

The values of the human ecology framework set out in this section are as follows:

1. It provides an operational definition of sustainability that managers can apply to any context, and it conjoins biophysical sustainability with standards of justice and fairness.
2. It surfaces the pernicious role of often unseen internal feedbacks operating between sectors that are often seen as separate (e.g. urban planning, freeway construction, and health) and encourages managers of those sectors to collaborate towards common goals.
3. It focuses attention on a problem indicator (e.g. declining food security) as a symptom emerging from the system structure and ensures policy interventions are drawn towards changing the structure that is causing the symptom.
4. It distinguishes between the state of the system at a point in time and its change process. That means it allows for the range of states over time to be explored.
5. It operates with a few accessible concepts that enable shared understanding within the community or policy-making group as a foundation to the co-production of knowledge and decision making.
6. It can reveal how different actors in different contexts relate through shared common feedback structures. Thus, actors can learn from each other's successful interventions, even if the specific elements are different.
7. By focusing on changing state change behaviour by changing system structure, it helps avoid ultimately futile policy interventions that attempt to change the state of a single variable in isolation from the broader system of which it is a part.
8. It draws attention away from simple cause-and-effect relationships that are the proximate explanations of change to the ultimate drivers of change.
9. In most human-ecological systems, this quest for finding solutions that address the ultimate drivers of change involve identifying the 'goal' or 'purpose' of the system and the power of the discourse that legitimizes that goal.

In the next section we apply this human ecology framework to the kinds of problems endemic to food systems, drawing attention to the dominant discourse that is ultimately responsible for how food system problems are being framed.

3.3 The human ecology of food systems

In this section we focus on food security and food sovereignty as two major food discourses that influence the food systems' behaviour. We note that, conventionally understood, the former fails to adequately address the broader social, justice, and environmental aspects of food systems

(Lee, 2012; Wittman et al., 2010b). These aspects are the central concern of the latter discourse, and at a scale where governance of food systems becomes possible. However, the food sovereignty discourse is not without its shortcomings, notably in contexts where food shortages are endemic, its stance on global trade, and idealistic visions of smallholder farmers feeding the world (Aerni, 2011; Bernstein, 2014; Burnett and Murphy, 2014; Jansen, 2014). Both social systems and ecosystems are affected by food activities driven by the respective discourses, and both co-exist (Jarosz, 2014). Consequently, we discuss how the discourses propose solutions in the form of sustainable agriculture, sustainable intensification, and agroecology and the research opportunities available to explore how both discourses co-exist in food governance systems.

3.3.1 State of food discourses

Here we introduce food security and food sovereignty as two discourses that currently exist in food systems research and policy debates. Food security discourse is associated with technical, positivist approaches to tackling hunger through a mix of technological advancements and providing economic access to food (Maye & Kirwan, 2013; Jarosz, 2014). These ideas are globally prevalent in agricultural policies, research programs, and social activities throughout the world (Lee, 2012). Food security literature is focused on increasing food production to meet projected increases in population by 2050 (Maye and Kirwan, 2013) and thus promotes and legitimises supporting trade policies, corporate investments, and policies into specific sectors geared primarily to the economically efficient increases in volumes and distribution of food. Some of the propositions within the food security discourse include:

- Re-evaluating trade practices to ensure food availability throughout the world,
- Expand deliberation across stakeholders,
- Increase private labelling and governance systems,
- Develop biotechnology and sustainable intensification practice,
- Achieving nutritional opportunities, and
- Having greater dialogue between actors across scales. (Candel, 2014; Maye & Kirwan, 2013)

An alternative perspective is provided by food sovereignty. Defined as the right of nations and peoples to control their own food systems, including markets, production models, food cultures, and environments (Wittman et al., 2010b), food sovereignty came from civil society organisations, notably the peasant farmer group La Via Campesina. It promotes concern over the food security discourse being used to support large-scale agricultural development policies and technical solutions to world hunger (Desmarais, 2007), and its language has been used to mobilize alternative food production systems and civil society networks throughout the world (Wittman et al., 2010a). At its core, the food sovereignty discourse sees food as a fundamental human right rather than solely a market commodity.

The main propositions of the food sovereignty discourse include:

1. Treating food as a human right
2. Promoting equitable agrarian reform
3. Protecting natural resources
4. Reorganizing food trade
5. Ending hunger
6. Social peace
7. Democratic control over food policies

Food security and food sovereignty have been presented as contradictory and opposing discourses. The fundamental difference is that food security aligns with the interest of economic growth and global agricultural markets (Lee, 2012; Westengen & Banik, 2016). Food sovereignty is concerned with decision-making processes, cultural diversity, and environmental wellbeing. Presenting the discourses as opposing, however, is unhelpful in pursuing meaningful interventions in food system activities that lead to human and environmental wellbeing (Clapp, 2014). Instead of an 'either/or' argument, what is really needed is critical integration and empirical analysis of how both discourses can co-exist across scales (Jarosz, 2014; Clapp, 2014; Edelman, 2014, Leventon and Laudan, 2017). The debates on transitioning to sustainable food systems that include human rights and sustainable production concerns provide a platform for analysing how both discourses influence human wellbeing, institutions, and ecosystems.

3.3.2 State of human wellbeing in food systems

The health and wellbeing of consumers are affected by lack of balance in food choices and consumption habits, poor dietary intake, and obesity problems which stem from the commodification of food (Lawrence et al., 2010). Human wellbeing in food systems also includes the socio-economic states of food producers (Carolan, 2016). The framing of food security as commodity production problem to be primarily addressed through economic efficiency measures has prevented these broader human wellbeing issues from being addressed (Lang & Heasman, 2004; Westengen & Banik, 2016; Wittman et al., 2010b).

Health outcomes in food systems also relate to how nutrient and calorific deficiencies are being met, as they are critical to human development (IFPRI, 2015). Some of the major challenges include:

- Undernutrition, which poses threats to cognitive functioning, immunity, growth, and reproductive outcomes. People in low-income countries are most at threat from undernutrition, with child undernutrition creating long-term human development challenges (IFPRI, 2015).
- Excessive consumption can lead to over-intake of calories, yet still be nutrient deficient. This phenomenon has become increasingly common in industrialized countries over the last few decades, and rapidly growing middle-income economies are seeing upward trends

in the percentage of their citizens who suffer poor health from excessive and unbalanced food intake. Even low-income countries can have significant sub-populations of over-consumers, resulting in the so-called 'double burden' on their health care systems of having to cope with both over- and under-consumption (WHO, 2016).

- A mix of factors, ranging from easy access to energy-intensive foods and poor levels of physical activity, has contributed towards the negative health consequences of excessive consumption (Carolan, 2016).

People acting on the market-focused ideas from the food security discourse have largely prioritised the production of staple commodities to meet market demand (Lee, 2012). Total food output has outpaced human population growth, largely through the increased use of technology and policies supporting food trade. Agricultural technologies include mechanization and industrialization to increase production efficiency, fertilizers to increase soil and crop productivity, pesticides and herbicides to reduce losses, animal veterinary and feed improvements to boost growth rates and muscle mass, and genetic modification of crops (Ehrlich and Harte, 2015). These technological advancements have allowed for increased staple commodity production, such as corn, sugar, and soy. These bulk commodities feed into agri-businesses and are processed to make a range of products, which enter the markets like any other retail commodity. This distribution of food produced has been facilitated by an expansion in global trade, which has served to make a wide range of foods available relatively cheaply, although this cheap food has not realized the promise of adequate access to the world's poor, and by negatively affecting local producers, arguably reduced local food security (Wittman et al., 2010a).

The consequence of being able to mass-produce food items from staple crops has been to make a wide range of food products available that prompt comfort, convenience, and cheapness. As the food security discourse treats all products of a particular kind as 'like' all others of that kind of product, it cannot discern between product types on the grounds of their healthiness and offers little insight into the promotion and overconsumption of highly processed, nutritionally poor, and energy-dense food products. Within this discourse, the only way consumers interact with food systems is as economic agents, making food choices on the grounds of perceived value and preference. The health outcome of these choices is seen as the individual's responsibility, or the concern of the health industry, not a food security issue.

Alternatively, the food sovereignty discourse values the production of culturally appropriate localized food, providing consumers with a food options that reflect the constraints of regional conditions. Here, the focus is on producing a range of products for consumption through domestic markets, rather than staple commodities for global trade. Community networks, including non-commercial produce from sites such as urban gardening, encourage the distribution and consumption of local and culturally appropriate seasonal foods. These informal networks can also enable feedback between producers and consumers, creating adaptive behaviour to balance ecosystems' health and

human wellbeing outcomes (Davila & Dyball, 2015). However, the focus on local foods and seasonality can be problematic for many of the world's poor and consumers who live in countries that do not have sufficient productive agricultural land available. For example, smallholder farmers who are dependent on seasonal commodities for their income face 'hungry seasons' when they are unable to buy food from markets and their production is insufficient to meet their household's demands (Bacon, 2015). Many dense urban populations would simply be unable to meet their consumption needs from their regional hinterlands, or would have to accept a highly monotonous, potentially nutrient deficient, diet were they to try (Porter et al., 2014). It is then neither possible nor desirable that the food sovereignty discourse, as currently conceptualized as local production servicing local demand, be globally extended.

3.3.3 State of food-producing ecosystems

Food-related activities across the entire food system are estimated to contribute between 12% and 19% of global anthropogenic greenhouse gas emissions (Vermeulen et al., 2012). From production, to processing and manufacture, to distribution and retail and consumption, food system activities both affect and are in turn affected by water resources, biodiversity decline, land use changes, nutrient cycling, and ecosystem services (Vermeulen et al., 2012; Ingram et al., 2016; Deutsch et al., 2013). For example, land used for agricultural production is expected to expand by 110 million hectares in the coming decades in emerging economies (Alexandratos and Bruinsma, 2012)This is likely to result in food production being pushed into land areas with high conservation value (Montesino Pouzols *et al.*, 2014) and further intensification of existing food production landscapes. Intensification has serious detrimental effects; for example, the production of staple crops such as sugarcane, palm oil, rubber, and coffee have high impacts on biodiversity loss due as high and increasing global demand drives expansion of plantations and mono-cropping (Chaudhary & Kastner, 2016).

The food security discourse productivity focus has created a range of perceived solutions to environmental problems that fit within its over-arching narrative. For example, the term 'sustainable agriculture' has become dominant in governments, civil society, and private groups involved with food. A challenge lies in the fact that there has been a focus on attempting to identify what sustainable agriculture looks like, whilst failing to fully analyse the social relations that impact the development, uptake, and potential success of change in practices (Velten *et al.*, 2015). Another solution to environmental impacts of food production is 'sustainable intensification'. This solution focuses on producing more food within existing landscapes. There is a risk of focusing only on one variable within the food system (maximizing production) whilst ignoring other domains of sustainability (such as human wellbeing), thus not being a truly sustainable solution (Loos et al., 2014). These technical examples indicate that there is scope to integrate different cultural and social contexts into solutions and focus on more than solely improving food production.

The food sovereignty discourse differs in the solutions it proposes for problems in agricultural production and to improve ecosystem wellbeing. Food sovereignty literature and activists often use the language of agroecology. Agroecology is a knowledge-intensive way of producing food that maximizes on farm natural resources, closes nutrient cycles, reduces or avoids waste and losses, and reduces dependence on external inputs (Altieri, 1995; Gliessman, 2007; Tomich *et al.*, 2011). The mix of nutrient cycling, provision of ecosystem services, seasonality of production, and on-farm social relations created by agroecological farming present a way in which addressing a problem in one part of the system (production) can have wide implications in other parts of the system (such as food diversity in markets) and contribute to environmental wellbeing. Agroecology has expanded to more than an approach towards food production, and has created a social movement centred on restructuring how people relate to their food systems (Wezel et al., 2009). Inherently holistic, agroecology extends to include both producers and consumptions as agents within the food system, and thus has the potential to break down the typical conflict between rural–urban divide and replace it with a common alliance of mutual recognition of their co-dependence (Stuart, 2014). The political potential of more deeply connecting urban consumers with rural producers is high and can be facilitated by making both consumers and producers active agents in their food system (Davila & Dyball, 2015)

3.3.4 State of food institutions

Global food institutions have historically focused on agricultural supply, neglecting environmental and social concerns within food systems (Lee, 2012; Barling & Duncan, 2015). The World Trade Organization (WTO) has played a major role in creating rules for food flows across nations, yet the legally binding agreements have been criticized as harming poorer countries. The long history of agricultural protection policies has disadvantaged producers from the developing world. Agricultural development programs from global institutions like the World Bank and aid agencies have focused on prioritizing access to food and developing coping mechanisms for poor people. A dominant belief has been the idea that increasing agricultural productivity is the best tool for smallholder farmers to escape poverty, yet this has not occurred evenly throughout the world (Dethier & Effenberger, 2012). The Food and Agriculture Organization (FAO) has been responsible for creating global guidelines and metrics on food security and nutritional outcomes; however, they do not provide legally binding agreements for domestic institutions.

Domestic agricultural institutions include national governments that provide support and regulations to domestic food systems. They make strategic decisions based on their national interest, and are free to ignore many of the global, non-legally binding food guidelines global institutions put forward. Consumers in food importing nations, such as Japan, for example, have their food production standards determined by jurisdictions over which they have no influence other than by refusing to purchase from certain sources (Dyball, 2015).

Another major institutional player includes the private corporations involved in agricultural inputs and retail (Fuglie, 2016). Significant power has accrued to retailers who are able to source their inventories from almost anywhere in the world, effectively putting producers around the globe in competition with other, with orders place for the producer willing to supply at the lowest price, with associated negative impacts on social and environmental standards. Corporations have increased the control they have over the flow of food throughout the world through owning seeds, agrochemicals, food distribution outlets, and a large number of processed products. This has had implications on the types of nutritious foods available to consumers and the way farmers produce their food, as well as the food choices available to urban consumers (Carolan, 2016; Clapp, 2015).

Alternatively, informal institutions prevalent in food sovereignty discourses provide opportunities for learning, agroecological knowledge extension, and diversification of food diets (Wittman et al., 2011). For example, farmer-to-farmer knowledge exchange networks and field schools can act as a platform to learn agroecological production practices and reduce dependence on farm inputs and single-commodity incomes (Altieri & Toledo, 2011).

Food sovereignty is frequently attributed to local and national scales, civil society, or alternative movements that seek to break from the norm in their immediate food systems (Wittman et al., 2010a). However, food sovereignty interests have made it into formal institutions such as the Committee on Food Security within the FAO and a number of national governments (Brem-Wilson, 2015; Hospes and Brons, 2016). Despite lack of concrete evidence of the impact of this inclusion into formal institutions, the importance here is the fact that a civil society–driven discourse has permeated global governance systems, showing the opportunities of diversifying discourses in food systems.

3.4 Framework application

Having presented the state of human wellbeing, ecosystem, and institutions under the two food discourses, we can now contrast the behaviour and goals of the two food systems. From this, we will suggest two future areas of research based on the themes identified in this chapter.

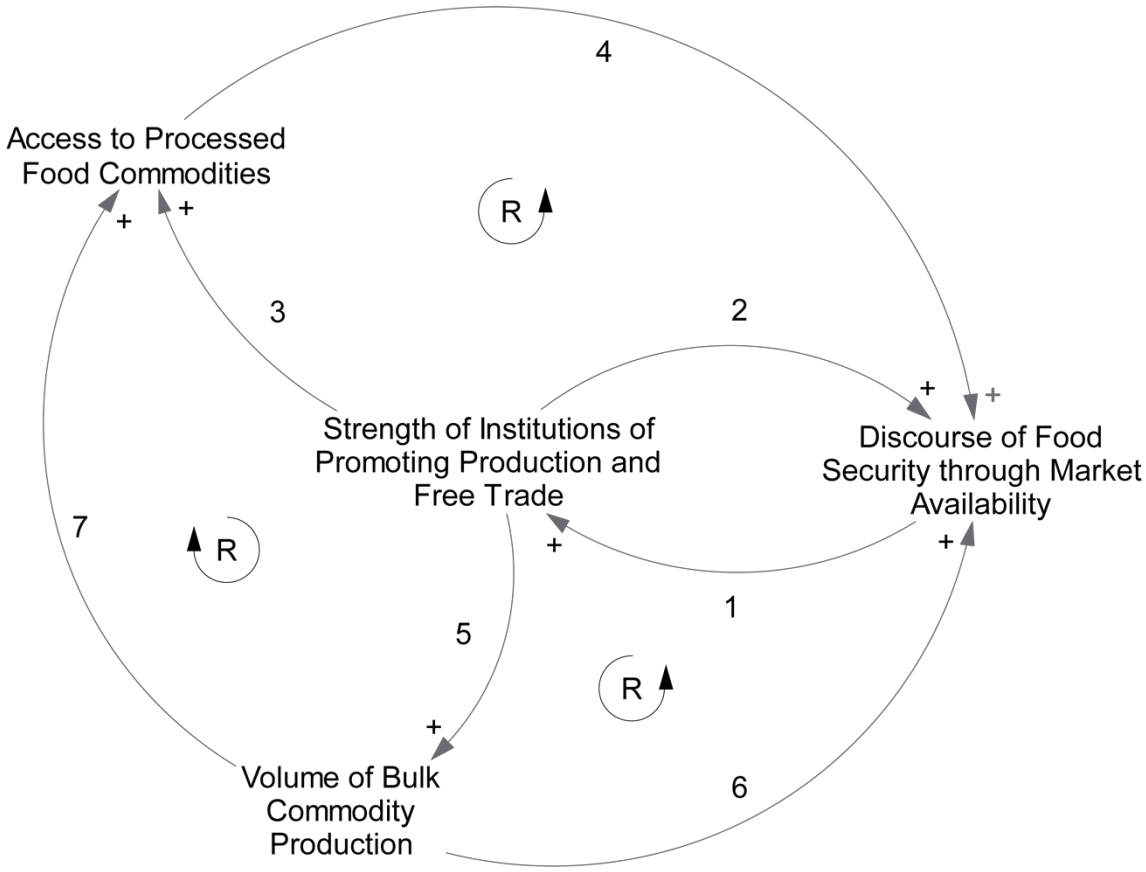


Figure 7: The food security discourse. All main feedback loops are positive, showing how advocates in this discourse's narrative believe more and more food becomes available, hence achieving universal security. The processes are discussed in Table 4.

Table 4: Processes that the food security discourse observes and values

Link number	Process represented by the link
1	This link is positive. The food security discourse holds that food security is best achieved by increased production volumes. Consequently, it acts to create institutions empowered to promote production and open markets to free trade.
2	This link is positive. Observations of the strength and effectiveness of free trade institutions further reinforce the discourse of food security through increased production. Any observations of production inefficiencies or barriers to trade are corrected.
3.	This link is positive. Consumer access to processed food commodities moves in the same direction as the strength of institutional support for food commodity systems.
4	This link is positive. The food security discourse is reinforced by observing levels of consumer access to food commodities. The discourse corrects for shortfalls between level of existing levels of access and complete access. It is neutral or antagonistic to food secured by means other than commodity system, because these are 'inefficient' in its narrative. The strength of the food security narrative is unaffected by other measures of health and wellbeing, such as obesity, as it does not monitor those variables. Other discourses, such as the population health discourse, would monitor variables such as obesity, and for that discourse this link would be negative, indicating the decrease in health from overconsumption of processed food commodities.
5	This link is positive. The presence of strong markets institutions for bulk commodities drives agriculture systems to increase their production of those commodities. Farms combine into larger systems, industrialize, mechanize, and become input intensive under a narrative of increased efficiency. Smaller farms that cannot compete go out of business. This may well include national producers as global free markets are uncaring where on the planet the food is produced.
6	This link is positive. The food security discourse is reinforced by large volumes of economically efficient produce feeding into the production of cheap, convenient food commodities. There may be some concerns that food security has been harmed where primary production has moved offshore and the nation become import dependent for key staples, but free trade agreements are seen as the solution to this. Other side effects of industrial food production, such as biodiversity loss, over-fertilization, animal welfare, or producer's pay and conditions are not monitored.
7	This link is positive. High yield produce from intensive farming systems directly correlates to the volumes of food commodities produced. Many other environment-to-human health links are negative, such as the degrading of other ecosystem services under intensive agriculture. However, these negative feedbacks are not considered aspects of food security and are not monitored.

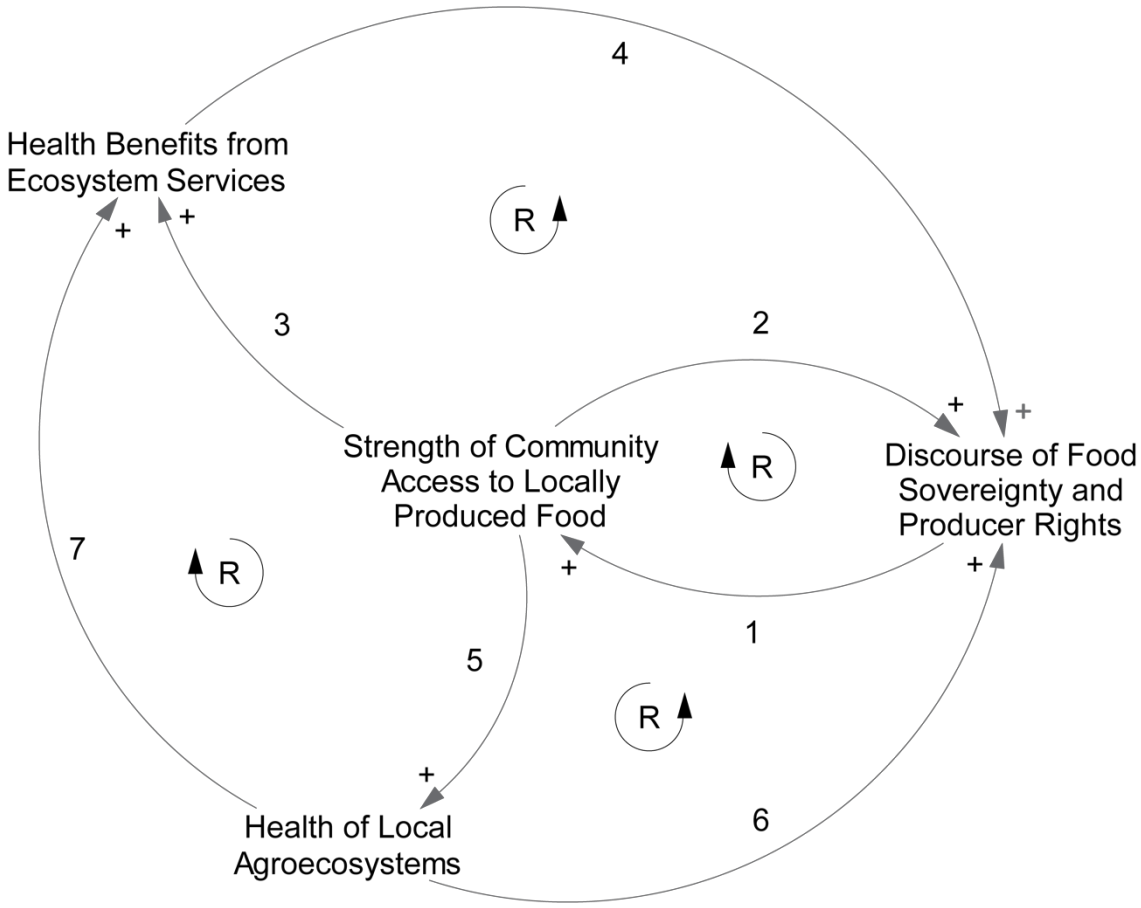


Figure 8: The food sovereignty discourse. Like the food security discourse, feedback loops in the food system are all positive, as the discourse itself believes them to be. The processes are explained in Table 5.

Table 5: Processes that the food sovereignty discourse observes and values

Link number	Process represented by the link
1	This link is positive. The food sovereignty discourse holds that food is the sovereign property of the producer and the region of production. Food is not a commodity – it is a right. Producers and consumers are to participate in food systems as mutually interdependent active agents. The discourse promotes local community markets and other spaces where this exchange can take place.
2	This link is positive. Observations of the vibrant community markets where consumers and producers meet in convivial relationships with mutual solidarity reinforce the discourse of food sovereignty. Little attention is placed on either consumers or producers who are, for whatever reason, unable to participate in this market – for example, for reasons of distance. If the region or nation is food import dependent, then, of necessity, some proportion of food consumption will not be produced locally.
3	This link is positive. Consumer access to healthy, locally produced, and culturally appropriate food choices moves in the same direction as the strength of institutional support for food local markets.
4	This link is positive. The food sovereignty discourse is reinforced by observing levels of consumer access to healthy food choices. Furthermore, the community members whose wellbeing is being monitored include the producers themselves. Consequently, the sovereignty discourse is equally reinforced by the economic and social wellbeing of producers and takes steps to correct the system if their rights are being violated. If the community is dependent for a proportion of its food consumption by producers external to the system, then this political concern for the producers' wellbeing is extended to them, even if it cannot be directly enforced.
5	This link is positive. The food sovereignty discourse places value on all ecosystem services, not merely its productive capacity. The health of agricultural landscapes is enhanced through such approaches as low-input, free-range, soil-first farming techniques, which are heavily reliant on the local knowledge and aptitude of the farmer.
6	This link is positive. The food sovereignty discourse directly monitors the health of the agricultural lands under its jurisdiction. Where it is forced by reasons of production shortfall to import food, it attempts to also monitor the health of the landscapes that produce that imported food through, for example, trustworthy labelling and traceable provenance.
7	This link is positive. The community experiences the direct health benefit from healthily produced uncontaminated and lightly processed food. It also directly benefits from a range of other ecosystem services that healthy farming landscapes provide, such as biodiversity refuges, water filtration, and carbon sequestration, as well as the cultural value of being surrounded by vibrant regional farming communities.

These diagrams shown in Figure 7 and Figure 8 indicate how different discourses influence the different variables in the human ecology framework. They show what the proponents of each discourse believe the goal of a food system ought to be and the power that they have to try to structure the food system to meet that goal. The diagrams also reveal each discourse's 'blind spots' – those variables that they do not see as 'part of' their system, but which in reality are affected by actions taken by the discourse's followers. This is in keeping with the basic system principle that you cannot change just one thing in a complex system. Cross-sector feedback practically guarantees that a

cascade of consequences will follow from your intervention. The problem that bedevils policy makers who are not alert to this fact is that the desired and intended consequences of your action typically appear immediately, whereas the unintended and undesired outcomes typically emerge after a delay.

We have provided an example in Box 1 of how detailed understanding of a food system, in this case from the Philippines, can be used to populate the framework variables. We have used evidence from our applied qualitative research experience and understanding of the literature to label the variables with Philippines food system information.

The Philippines comprise 7,000 islands occupying 300,000 square kilometres. Approximately 100 million people inhabit the Philippines, half of which remain in rural areas.

State of human wellbeing

- Agriculture is a major employment sector and land use activity in the rural Philippines. Poverty is three times higher in Filipino agricultural households than in non-agricultural households, and two-thirds of the poorest Filipinos depend on agriculture as their main income (UNDP, 2013).
- The main Filipino diet consists of rice, fish, and vegetables. As access to foreign imports has grown, the consumption of starchy roots has declined and the consumption of fats and oils has increased.
- The Philippines has severe levels of stunting (33.6%) and underweight (20.2%), and medium severity in wasting (7.3%) amongst children aged 0 to 5 years. The nutrition Millennium Development Goal was not met, with the final report stating that malnutrition prevalence for children under 5 was 20.2%, failing to meet the target of 13.6%.
- One out of every ten Filipinos still relies on household food production and cannot purchase additional foodstuff to meet other nutritional needs.

State of ecosystems

- Food in the Philippines is produced in mega-biodiverse landscapes.
- The intensification of agriculture has had impacts on the country's biodiversity. Of the 167 different mammal species, over 60% are endemic, and 65% of the over 10,000 plant species are also endemic (Goldman, 2010).
- Since Spanish colonization in 1565, forest cover has decreased from 90% to 18% (Wagner et al., 2015).

State of institutions

- A range of socio-economic challenges, including weak governance, corruption, lobbying, and increased human population, inhibits biodiversity conservation action in the Philippines. Furthermore, there are little policy synergies between pursuing agricultural expansion and self-sufficiency and stemming biodiversity losses.
- National policies promote agricultural expansion and intensification, leading to severe environmental degradation (Coxhead et al., 2001).
- Policy support for staple commodities such as rice, sugar, and maize have narrowed the focus on rural development and failed to create a diversity of livelihood opportunities (UNDP, 2013).
- Land reform is a major issue, with smallholder farmers being tenants and having little influence in agricultural policies.

State of discourses

- A focus on staple commodities has driven agricultural policies and extension programs.
- Food has been framed as a commodity, and the food system in the Philippines shows the focus on sugar, coconut, and bananas as the main interest.
- A single-commodity focus has deprived rural areas from diversifying production and generating diverse economic opportunities from agricultural landscapes.
- Farmers have little capacity to influence political and policy processes that affect their food system.

Box 1: The human ecology of Philippine food systems

The analysis of the Filipino smallholder food system portrayed in Figure 9 and discussed in the accompanying Table 6 suggests key points of intervention. One is to strengthen feedback process L4 so that farmers have more influence on government policy, for example, by actively lobbying for support for agroecological training. At the same time, switching away from policy focus on

commodification to one on income diversification, innovation, and local value-adding would make process L3 a positive link. As a consequence, feedback loops L1, L3, and L4 would become reinforcing (as all the links would have positive polarities) and the current balancing loop which is trapping farmers in poverty would be replaced by one in which their income grew to at least above a minimally acceptable dignity threshold.

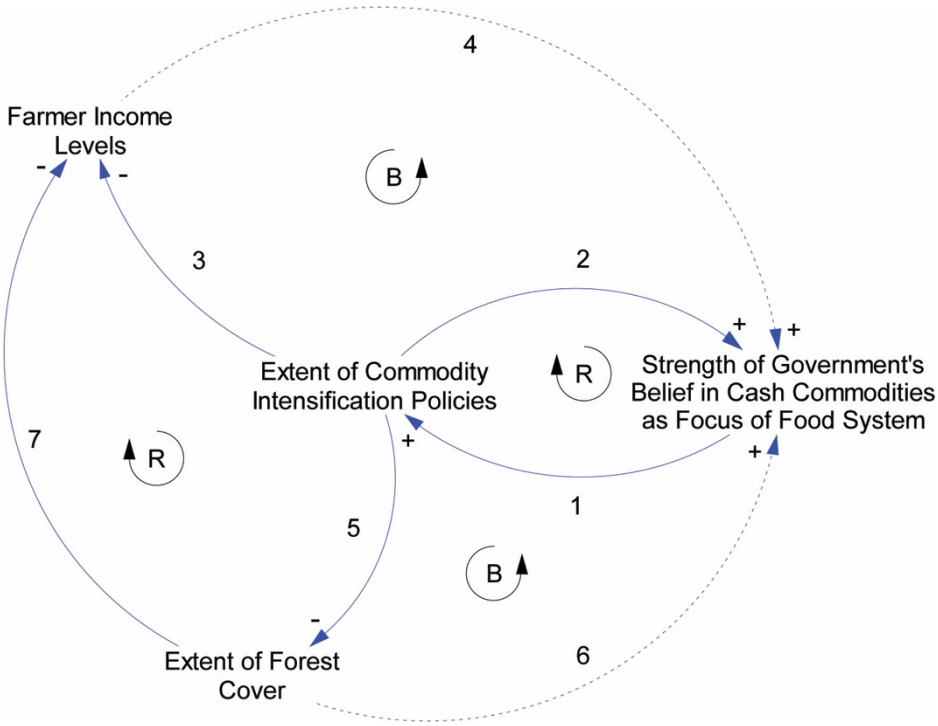


Figure 9: The Philippine food system for smallholder cash commodities. Farmer incomes are trapped at low levels by undesirable balancing (B) feedback loops. Forest cover declines as they are driven to pursue land clearing to try and break out of their commodity

The process represented by the arrows is discussed in Table 6.

Table 6: Processes driving the Filipino food system

Link number	Process represented by the link
1	This link is positive. Two decades of policy orientation to increased productivity demonstrate the strength of the government's belief in commodities (Cororaton & Corong, 2009).
2	This link is positive. Observations of declining agricultural productivity during the last two decades are responded to with increasing effort to strengthen institutions charged with enacting intensification policies.
3	This link is negative. As intensification efforts go up, farmers' incomes go down. Rural incomes are especially vulnerable, with over 30% spending over half their income on food. Figures for poor nutrition, especially in children under the age of 5, are representative of the negative effects on the state of health and wellbeing.
4	This link is positive but weak. If farmer income went up, it would reinforce the government policy. In fact income is going down and that should drive policy in the same direction. That is, falling farmer income ought to cause the government to change its stance, but does not. This represents the weak influence rural smallholders have on policy and government decision making.
5	This link is negative. As the policy of commodity intensification goes up, the behavioural response is the activity of land clearing, and so the forested land area goes down. The state of this variable is currently 18% of land cover and falling.
6	This link is positive, but weak. If forest cover were to go up under commodity intensification programs, that ought to drive policy in the same direction (i.e. strengthen it). In fact forest cover is going down, so that ought to weaken the policy. Lost biodiversity ought to concern policy makers because, for example, this could negatively affect tourism and associated income. However, as agriculture and tourism are seen as different policy sectors, the signal to the agricultural policy makers is weak.
7	This link is negative. As the farmers have few other options to try to escape their commodity trap other than to expand areas of production to increase total volumes, any efforts to increase forest cover would negatively affect their income. The consequence is ongoing farmer efforts to clear forest cover as one of the few strategies left to them to increase their income. With delay there is highly likely to be harmful consequences for the farmers of this strategy as a range of ecosystem services are lost. Farmers may be aware of this, but the short-term demands of their immediate perilous state of wellbeing do not give them the luxury of taking this longer view into account.

Another intervention point is to strengthen process L6, for example, by revealing cross-sector feedback from agricultural policy to tourism. If this weak link were strengthened, this would stop processes L1 and L5 from functioning as an influence chain, driving forest cover down, and become a balancing feedback loop. The extent of forest cover would then be balanced against other demands but maintained around a stable state. If the positive feedback loop described earlier were to be created to lift farmers out of poverty, this balancing loop would place a brake on how affluent they could then become, or at least how much additional affluence could be achieved without degrading forest cover.

The ultimate goal would be to change process L5 so that it was not a negative. This would to create a biosensitive economy in which increased human wellbeing did not come at the expense of a trade-off against environmental health and associated ecosystem services. If this were possible,

the co-effects loop linking processes L1, L5, L7, and L4 would all be positive and environmental health would increase as human wellbeing increased. This could happen under a bio-mimicking circular economy in which living energy pathways drove the increased rate of nutrients through closed cycles, allowing the overall carrying capacity to increase. Such an economy would only be possible with a significant shift in the dominant discourse, from one that believed that a growth economy was the only path to community wellbeing to a biosensitive discourse that believed in living in harmony with a human-modified natural process. This would achieve what Ravetz (2006, p. 281) calls a 'revolution in consciousness' because it would reject the process of increasing linear resource appropriation as a requisite for the increasing the material basis of what constitutes 'living well'. Such a revolution would overcome the 'contradiction' of trying to solve the problem of poverty and natural resource degradation by the further application of the process of expropriation that created the problem in the first place.

It is one thing to describe future food systems that have the structure discussed previously, and quite another thing to plausibly imagine how the politically revolutionary changes to create it might come about. The reason for adopting an approach compatible with post normal science was due to instrumental science's ability to say what is, yet its impotence in saying what ought to be, let alone how society might get there. Aligning with post normal science, human ecology, as discussed earlier, is overtly normative in that it seeks to critically reflect on problem situations, precisely to change them into some better situation, both socially and environmentally. However, human ecology has not typically engaged with analysis of the role of political power in structuring systems as they are and the capacity of those wielding that power to resist change. We cover this issue in the next section, as political and power relations in a food system play a critical role in the system's behaviour.

3.5 Future research

In this chapter, we have framed food systems as a wicked problem and human ecology as a framework for pursuing interdisciplinary research and practice. The use of this framework can focus on mediating between the uncertainty of facts, competing values, and urgent actions needed for sustainable futures. To show the value of human ecology, we concentrated on two dominant discourses that influence the state and outcome of a food system. What is evident from the vast literature on food security and food sovereignty is that one discourse (food security) is dominant amongst public institutions, corporations, and food producers. The dominant focus on commodity production has made other discourses focused on ecological and human wellbeing subordinate, preventing them from meaningfully influencing the outcome of a food system. In this concluding section, we propose that in order to expand research into food discourses in food systems, critical attention needs to be given to issues of power and social relations. Doing so will require a range of methods capable of capturing human activities and behaviours and the broader connections between discourses and power in specific community groups. Such methods and analysis will need to be

specific to the context in which a selected food system operates, yet findings and analysis will need to be relevant to the broader global debates presented in this chapter.

Here, we will argue that the following areas of study are needed in future food systems research:

- Food governance as a process that influences ecosystems, human wellbeing, and institutional behaviour. A focus on process can help explore how food sovereignty can expand from a subordinate to a dominant discourse.
- Taking an explicit political angle to food systems, and more broadly, sustainability science. Politics is the process whereby discourses are formed and changed, and as a change in the dominant discourse is a necessary component of moving towards just and sustainable futures, politics is a major driver of sustainability.

Both of these areas of study are critical for sustainability because they extend beyond the interest of academics and researchers – they encompass the interests of the diverse group of stakeholders concerned with the outcome of the food system. This is critical for future pathways in transdisciplinary research, which require the identification of problems and solutions by a range of stakeholders and the formation of democratic extended peer communities, discussed in the earlier sections of this chapter.

3.5.1 Food governance

Governance deals with the processes and structures that influence individual or collective action that lead to the realization of a collective goal (Young, 2002). With major environmental change occurring at unprecedented rates, governance needs to become more adaptive and reflexive to deal with uncertainty and unexpected system behaviour (Hospes & Brons, 2016). Food governance is carried out by the different institutions and actors presented in this chapter and is influenced by the competing discourses. The interactions between these groups offer an opportunity to explore the competing beliefs and discourses held by different agents (Candel, 2014). Governance is inherently a social process, and as such it would be adequate to study it within a human ecological framework. Future research can focus on discourse co-existence and how this transfers to individual and institutional actions. Case studies can be used to understand how different discourses co-exist in specific food systems. More broadly, the study of the social dimensions of sustainability is critical, given historical traditions of focusing on biophysical changes whilst ignoring socio-cultural values (Lövbrand et al., 2015).

The use of frameworks concerned with human and ecological interactions can contribute to the broader evidence base of how social systems can adapt to and manage global environmental change (Lövbrand et al., 2015). Empirical qualitative data will need to be gathered through inter- and transdisciplinary methods to capture the diverse ways of framing food problems and solutions in specific contexts. Researchers will need to work with extended peer communities to negotiate agreed normative standards for improving both human and environmental health, seen as co-extensive

aspects of what it means to 'live well' (Dyball, 2010; Dyball, 2012). To achieve this and have tangible social applicability, research needs to embed contextual and political realities into its analysis. For this, explicitly politicizing food systems research can help inform future food system governance and policies that lead to environmental and social equity outcomes.

3.5.2 Politicising food systems research

As food is often produced on biodiverse landscapes by lower socio-economic–resourced groups, politics is a major issue. The literature on the politics of natural resources extensively documents how peoples' interactions with one another influence environmental outcomes (Robbins, 2012; Zimmerman and Bassett, 2003b). The political nature of food systems is at the core of the food sovereignty literature (McMichael, 2009a) however, there is much potential to bring this into the realms of human ecology and broader sustainability science. Doing so will broaden the disciplinary perspectives required to tackle sustainability problems.

Whereas the food security literature is often apolitical and reports on environmental and social outcomes, the food sovereignty literature has taken a much more explicit focus on the politics of food. The issue of decision-making control and power is a major one throughout different scales in food systems (Hospes & Brons, 2016). The power of key food corporations, trade systems, and retailers to dominate the flow of staple commodities, and associated prices, increasingly disadvantages all producers, and small-scale producers especially. As mentioned, much of this private commodity control is simply unregulatable sitting beyond any sovereign jurisdiction (Christensen, 2015). Without critical analysis of the social and power relations in a system, we are likely to leave unchanged the traditional ways of understanding and addressing problems, and hence covertly support the power relations of the status quo.

Exploring political issues in sustainability requires bridging the technical understandings from the sciences with the critical social analysis of the social sciences. Studying and critiquing how social behaviours and assumptions inform how we understand, act, and adapt to environmental change is a major research opportunity (Lövbrand et al., 2015). Bringing these social issues to transdisciplinary research forums can have ramifications for stakeholders, dependent on their social status within that system. Problem mapping frameworks, such as human ecology, help highlight the tensions caused by power in a system and bring shared understandings on possible future interventions. The critical social sciences provide ideas from Marxism, constructivism, critical theory, Foucauldian concepts of power and knowledge, and feminist perspectives to document how historical contexts have crafted social structures influence behaviour (Stevenson, 2015). Developing integrative research that uses this disciplinary and theoretical diversity can further inform the study of the social drivers within food systems.

3.6 Conclusion

In this chapter, we have:

1. Demonstrated how human ecology helps identify the influence that different discourses have on perspectives and solutions for food system challenges,
2. Proposed a future food systems research agenda that acknowledges and integrates governance and politics, including issues of power.

We achieved our first objective through highlighting how food discourses align with the concept of applied post normal science and with different literatures concerned with human wellbeing, ecosystems, and institutions. Global food systems have created a wide availability of relatively cheap, convenient, and satisfying food products, but this has created unhealthy eating habits, and food has failed to reach the most vulnerable. Tensions are prevalent between pursuing agroecological production that can expand food outputs and achieve biodiversity outcomes versus continuing highly technical production that meets global market demand and increasingly reflects the power of global retailers. Institutions modelled on the principles of dominant discourses play a critical role in facilitating food activities and have the potential of influencing all producers, processors, distributors, and consumers. To have this influence altered so it restructures food systems to promote more just and sustainable outcomes, enhanced understandings of food governance is needed, and particularly the role of dominant discourses.

We achieved our second objective by arguing that governance is a process that brings together different perspectives on an issue and can be enhanced to maximize the value of different proposed solutions. Wider discussions into governance for sustainability and the value of critical social research in the context of environmental change make food governance research a critical research avenue to pursue.

Food systems scholarship is rapidly growing and can be enhanced through more deeply integrating critical social science analysis within its concerns for sustainability. The human ecological framework used in this chapter provides an analytical tool for drawing links between literatures and specific elements of a system of interest. The food literature indicated that explicitly embedding power and politics into analysis is crucial, as it is a major driver of how people engage with food activities. The use and expansions of these critical human ecological and social science methods will be of value to the future of the food systems research agenda's ability to meaningfully discuss and inform food governance and policy debates and action.

The complexity of food systems requires the integration if disciplines to analyse and intervene in problems (Foran et al., 2014). This integration of disciplinary lines of enquiry can aid the development of inter- and transdisciplinary research processes needed to address food problems, and more broadly, sustainability challenges. Human ecological analysis offers a platform for identifying links between ecosystems and human wellbeing and can be enhanced by those disciplines that can contribute towards bringing political and power analysis into central consideration.

Chapter 4: Human ecology and food systems: Insights from the Philippines

Full reference: **Davila, F**., 2018. Human ecology and food systems: Insights from the Philippines, *Human Ecology Review,* 24(1): 23-50, Available at: http://doi.org/10.22459/HER.24.01.2018.02

Status: Published in 2018

Building from the literature review in Chapter 3, this chapter continues to answer the thesis question: *How does the human ecology framework help guide analysis of food system discourses?* The chapter also contributes to the thesis question: *What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?* In this chapter I apply the human ecology framework in the context of Philippines food systems, and introduce the historical and institutional context of Philippine agricultural systems. I present a historical overview of how a maladaptive food system geared towards high output agriculture has marginalised smallholder farmers, creating challenges for increasing their role as active agents of change in their food production landscapes.

4.1 Introduction

Feeding the world sustainably is a major global challenge that requires balance across sociopolitical tensions, nutritional and aspirational needs of a growing population, ecosystem stability, and climate change (Rockström et al., 2016). Despite being a heavily debated concept, food and nutrition security is commonly understood as a normative global policy objective that is achieved when all people have access to sufficient safe and nutritious food to meet their dietary needs and preferences for an active and healthy lifestyle (Food and Agriculture Organization [FAO], 2017). Yet, despite an apparent abundance of food in world markets, 815 million people remain hungry, one billion lack micronutrients, and two billion are overweight (FAO, 2017). Traditional approaches to solving food and nutrition security challenges have focused on maximizing production of specific commodities, often neglecting broader human and environmental issues (Ingram, 2011). To address this neglect, systems-based approaches have emerged as a way of identifying drivers and feedbacks that influence food activities (Ericksen, 2008; Ingram, 2017; International Panel of Experts on Sustainable Food Systems [IPES Food], 2015; Marin et al., 2016). The concept of food systems acts as a normative way of contextualizing food research and policies (Ericksen, 2008; Ingram, 2011; Ingram et al., 2010).

A food system (Figure 10) is made up of interactions between biophysical and human systems that influence food activities ranging from production to consumption (Ericksen, 2008). Food systems operate across spatial and temporal scales, and are managed to deliver food and nutrition security while attempting to reduce negative environmental and social impacts (Ericksen, 2008; Ingram, 2011; Ingram et al., 2010; IPES Food, 2015). The food systems concept is a mental construct that allows researchers and practitioners to conduct analysis on specific individual and collective activities, and their interactions with environmental changes (Ingram, 2017). The food systems concept is not new; McMichael (1994) and Sobal et al. (1998) debated initial systems-based approaches to analyzing global food challenges in the 1990s. The lack of coherent focus on feedback between environmental change and food insecurity led to a redeveloped food systems concept (Ericksen, 2008; Ingram, 2011), which enables interdisciplinary study design and conduct. Recent social sciences studies have examined the social drivers of change in food systems, and there has been growing interest in food systems governance and institutional studies (Hospes & Brons, 2016; Candel, 2014; Termeer et al., 2018), how the political economy affects equity issues associated with trade systems (Clapp, 2015, 2017), and how environmental and political issues interact to influence food system feedbacks (Galt, 2013).

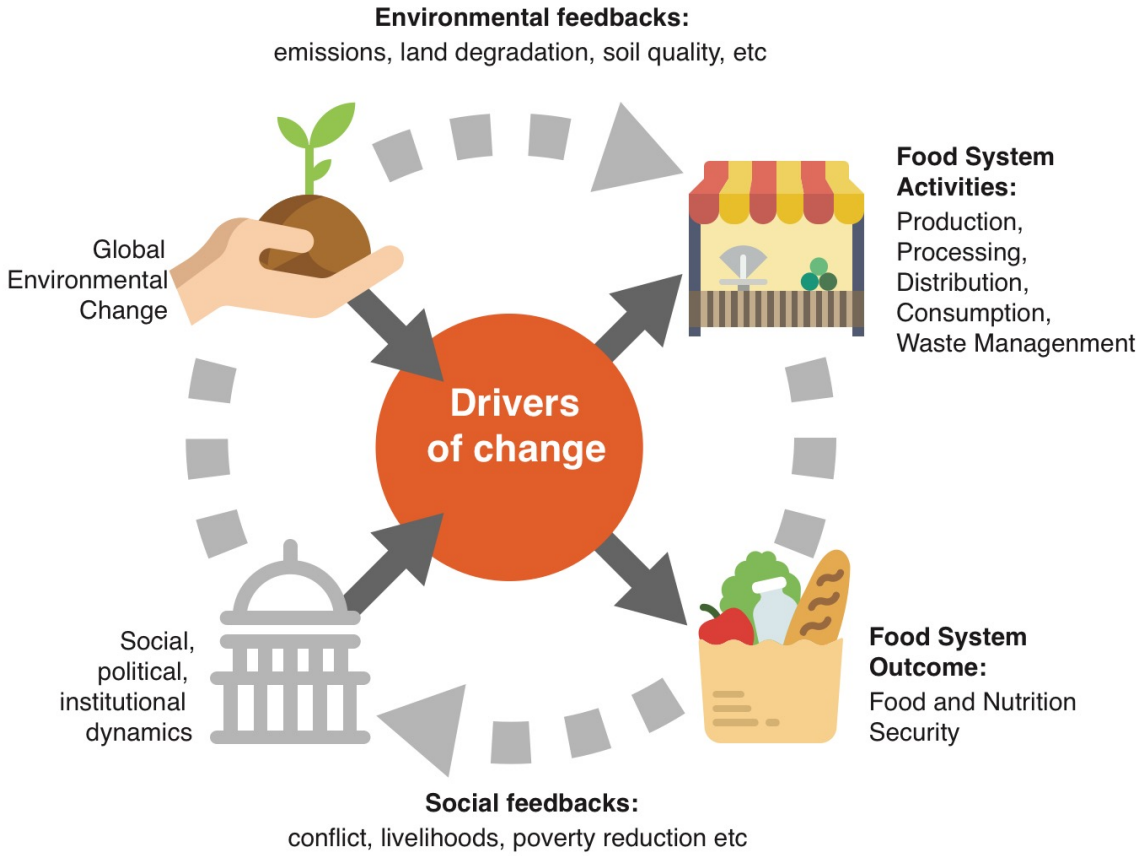


Figure 10: Food system drivers, activities and outcomes, based on Ericksen (2008), synthesized by the author

The ongoing use of food systems as a platform to study human ecological interactions presents an opportunity to explore how human ecology frameworks can contribute to food systems scholarship. Human ecology offers a coherent systems-based approach for capturing the underlying discourses that influence food activities across scales (Davila & Dyball, 2017; Dyball & Newell, 2015), notably, the ongoing institutional and political interactions between global market-driven food security and community-oriented food sovereignty (Leventon & Laudan, 2017; Candel, 2014). Discourses are the underlying ideas that stimulate human activity and collective action (Dryzek, 1997). Studies into food discourses are extensive, yet there remains a need to study how competing discourses exist in particular contexts, their origins, and the implications for transdisciplinary research into future food systems (Marin et al., 2016). Human ecology is defined here as an analytical framework (see Figure 11 and Table 7) that captures the underlying discourses and associated feedbacks of these on institutions, human wellbeing, and ecosystems. Four major variables—state of discourses, institutions, human wellbeing, and institutions—align with major elements of the food systems concept, showing complementarity between the frameworks (Table 8). The novel addition of human ecology introduces a focus on food discourses in a specific context and its influence on the system's behaviour (Davila & Dyball, 2018).

The aim of this paper is to show how human ecology helps to identify the dominant discourses that influence the social drivers in food systems. This is demonstrated through documenting the historical legacies of agricultural commodity production systems in the Philippines since Spanish colonization, as well as the human ecological consequences of these. The Philippines comprise 7,000 islands occupying 300,000 km^2. Approximately 100 million people inhabit the country; half that number remain in rural areas working largely in agriculture. More than one-quarter (25.8%) remain below of poverty line (Philippine Statistic Authority, 2014a). The total agricultural land—approximately 125,000 square km (FAO, 2011)—contributes 12–20% of gross domestic product (GDP) (Cororaton & Corong, 2009). Over half the population depend either directly or indirectly on income generated through agricultural production (United Nations Development Programme [UNDP], 2013). An ongoing focus on staple commodities such as rice, sugar, and maize has narrowed the focus on rural development opportunities and failed to create diversity of livelihood opportunities (UNDP, 2013).

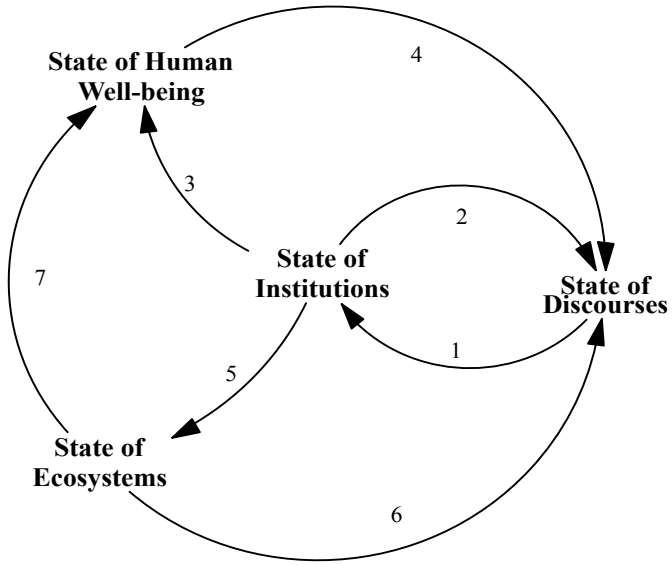


Figure 11: The human ecology framework

Table 7: Explanation of links from Figure 11

Link number	Process represented by the links in Figure 11
1	The influence that a dominant discourse has on generating formal and informal decisions among individuals or institutions. This includes planning and goal setting resulting in the design and implementation of policies to promote the dominant discourses in society.
2	As formal and informal institutions learn from experiences, they will either reinforce or change the dominant discourse. Dominant discourses may change or resist change, as other institutions might reinforce it. If they were changed, they would influence the formation of new institutions to reflect the new discourse.
3	This link shows the implications of institutional decisions on an individual or a community's physical and psychological wellbeing.
4	As communities and individuals change based on institutional activities, dominant discourses may shift, eventually creating new institutional interventions. As with L2, these observations may challenge or reinforce core values, depending on circumstances.
5	This includes collective activities promoted or enabled by dominant social institutions that directly affect the environment.
6	As ecosystems change based on formal and informal institutional activities, new discourses may emerge or dominant discourses may be perpetuated.
7	Ecosystems are affected by policies and human behaviour and, as ecosystems change, they directly affect human health and wellbeing.

Table 8: Links between human ecology and food systems

Human ecology framework variable	Overview	Relevance to food systems concept	Further reading
State of discourses	Refers to the collectively held ideas that frame the nature of a problem. Discourses may not be shared equally, but the framework draws attention to those that are dominant and most responsible for a system's behaviour. At the same time, the framework can reveal alternate discourses that are currently marginalized or oppressed but that, if empowered, could set different goals for the system.	The food systems concept identifies social activities as key drivers of change in the system. The study of discourses sheds light into how individuals and institutions have come to frame food problems and, hence, how they interact with the system.	Hospes & Brons (2016) Jarosz (2014) Rivera-Ferre (2012)
State of institutions	Describes the social institutions that the community has established to govern their collective behaviour. These are the formal and informal rules and institutions that facilitate a community's actions. Formal institutional rules manifest as policy instruments, such as taxes, regulations, and education programs. Informal institutional rules are those tacit regulations that influence what a community judges to be appropriate "normal" conduct.	Institutions, formal and informal, are responsible for managing landscapes and food production. This includes smallholder farmers' organisations, multiple public agencies, and private corporations, among others.	Candel (2014) Chaifetz & Jagger (2014) Clapp (2017)
State of ecosystems	Includes both the natural environment and anthropogenically constructed artefacts, such as agricultural landscapes, buildings, roads, and vehicles.	Infrastructure provides an avenue for different actors to produce, distribute, consume, and dispose of food products. Natural ecosystems provide crucial services to agriculture, yet food activities continue to pressure these ecosystems through intensive practices.	Ingram et al. (2010) McIntyre et al. (2009) Vermeulen et al. (2012)
State of human wellbeing	This captures the physical and psychosocial aspects of what it means to live well. This includes indicators of good health, such as adequate nutrition. The arrows that link the four variables are feedback processes or activities that influence, positively or negatively, the metavariable.	Food and nutrition security is a heavily debated concept, yet there is general agreement that this ought to be the goal of a food system. This aspect of human wellbeing can have long-term human development impacts through healthier communities.	Sobal et al. (1998) Zamora et al. (2013) Fanzo (2014)

The dominant Philippines food system is defined here as one that focuses on production of commodities for international markets, supported by high productivity-oriented policies and technological development (Davidson, 2016; Timmer, 2014, 2015; UNDP, 2013). This system was selected because the country's dominant land use continues to be oriented toward key cash crops,

which often encroach on traditional and indigenous local food systems (Borras, 2007; Cororaton & Corong, 2009; Timmer, 2015). This paper builds on previous human ecology work conducted on Philippines food systems (Carpenter, 2003, 2010; Rambo & Sajise, 1984) and contributes to growing regional efforts to expand from agroeconomic and technical approaches to food studies (Depositario & Saguiguit, 2014). The paper contributes to growing interest in expanding from traditional disciplinary-based approaches of agricultural development toward more integrative systems-based ones that capture competing stakeholder understandings of food and nutrition security, both in the Philippines and globally (Depositario & Saguiguit, 2014; Jarosz, 2014; Leventon and Laudan, 2017; Marin et al., 2016; Southeast Asian Regional Center for Graduate Study and Research in Agriculture [SEARCA], 2014).

The next four sections populate the human ecology framework with interdisciplinary literature from the Philippines. The "state of human wellbeing" variable presents issues of nutritional wellbeing for human development and income inequality in rural agricultural landscapes. The "state of ecosystems" variable shows how dominant commodity production has led to deforestation and affected the country's unique biodiversity; the growing threat that climate change presents to the food system is also discussed. The "state of institutions" section narrates how different policy and land use practices were established by Spanish colonizers and built on by the United States (US) before the country's independence. The institution and trade systems that were established paved the way for the dominant practices of distributing and managing land. The "state of discourses" variable presents the tensions between productivity-oriented production and farmer-led learning activities, demonstrating the tensions between the dominant discourse of production and the marginalized discourses of alternative food systems. After synthesizing this material into the human ecology framework, I discuss the positive, negative, and weak feedback processes in the system, and consider several possible points of intervention. The paper concludes by identifying the contributions that human ecology makes toward systemically analyzing social drivers in food systems.

4.2 State of human nutrition and economic wellbeing

The national Philippine food system is not delivering adequate food and nutritional security outcomes to the Philippines population (Davidson, 2016; Philippine Statistic Authority, 2014a). The incidence of poverty in agricultural households is three times that of non-agricultural ones, with farmers often facing "hungry seasons" when crops are not produced or climate shocks affect production (Reyes et al., 2012). By contrast, urbanized food systems, which provide reliable access to imported processed foods, have overdelivered, leading to obesity challenges in urban centers. Nearly one-quarter (24%) of the national adult population is overweight and 5% is obese (International Food Policy Research Institute [IFPRI], 2015). Rapid population growth has concerned policy-makers for decades (Davidson, 2016; Zamora et al., 2013) and two broad focus areas have driven food and nutrition security policies. The first focus area has centered on improving

farm productivity to create market surplus of staple commodities in an attempt to secure domestic self-sufficiency (Coxhead et al., 2001; Stone & Glover, 2016). This focus area has prioritized the access, stability, and availability dimensions of food security, and has seen relative annual agricultural growth of 4%. However, despite moderate income increases, the high cost of agrochemical inputs, climate shocks, and market access inequality has perpetuated poverty in rural areas. The incidence of poverty remains high in rural areas, with agrarian reform policies and market-led development failing to provide trickle-down benefits to farmers (Borras, 2007; Reyes et al., 2012).

The second focus area has been nutritional programs targeted at lower socioeconomic groups that prioritize food utilization (Zamora et al., 2013). An estimated 17% of Philippine people do not meet their nutritional requirements and basic needs (Heckelman & Wittman, 2015). Even when food is available, utilization might not be possible due to a lack of knowledge of healthy diets or access to clean water. Indigenous food production systems, including upland swidden systems, continue to provide basic food for families that have limited income opportunities and face multiple pressures from market-led development and agricultural policies (Cuevas *et al.*, 2015; Dressler, 2005). Philippines food security is dependent on food imports to meet domestic demands for rice, a major cultural dietary staple (Davidson, 2016), making the country vulnerable to potential market shocks that see reductions in trade. When compared to global standards set by the World Health Organization's baseline indicators, the Philippines has severe levels of stunting (30.3%) and underweight children (19.9%), and medium severity in wasting (7.9%) among children aged zero–five years (IFPRI, 2015).

The food and nutrition security outcomes of the Philippine food system are not being achieved (Davidson, 2016). The state of human wellbeing is highly inequitable, with rural communities marginalized from development processes that have prevented their ability to achieve nutritious diets. The dominant support for staple commodities has created a system in which farmers depend on low incomes from cash crops, and landscapes have been modified to meet this international market demand. The ecological consequences and implications of this modification are discussed in the following section.

4.3 State of agroecosystems

Economic development policies in the Philippines have supported a series of industries that have had major impacts on land cover and natural resource use, such as mining, logging, and industrial agriculture (Bankoff, 2007; Davidson, 2016). In agriculture, land has been used to produce key commodities for domestic and international markets, posing threats to the country's unique biodiversity. The Philippines is home to rich ecosystems, with high rates of species endemism. Nearly half of the documented 1,100 terrestrial vertebrates are unique (Posa et al., 2008), and 60% of the 167 different mammal species and 65% of the over 10,000 plant species are endemic (Goldman, 2010). Heaney et al. (2016) found high levels of mammalian endemism in the main island

of Luzon and discovered an additional 28 mammal species, nearly all endemic to the island. Marine ecosystems are equally diverse, with the Philippines being part of the Coral Triangle of the Pacific. The Coral Triangle has approximately 600 different species of reef-building corals, nurtures six of the world's seven marine turtle species, and more than 2,000 species of reef fish (Goldman, 2010). This diversity, which makes the Philippines one of the world's megabiodiverse countries, presents a major opportunity for developing food system activities that can support and sustain it.

Human activity has modified and affected Philippine ecosystems. Posa et al. (2008) identified habitat destruction from agricultural and forestry practices as major contributors of biodiversity loss in Philippine landscapes. These activities have stemmed from a range of socioeconomic challenges, including weak governance, corruption, lobbying, and increased human pressures. A combination of these factors has inhibited the progress of conservation action in the Philippines, despite a long history of civic engagement (Goldoftas, 2005). The lack of integration between conservation policies and other development priorities, such as rural development, has led to rapid landscape degradation (Maohong, 2012). Conservation activities need to compete with the continuation of national policies that promote agricultural expansion and intensification, inevitably perpetuating environmental degradation in the current production-oriented model (Coxhead et al., 2001). A series of national government bills have generated a policy discourse of ensuring national self-sufficiency in key commodities to secure food for the country, especially in rice (Davidson, 2016). This ongoing focus on land expansion for production practices continues to negatively affect the country's unique ecosystems (Wagner et al., 2015).

Coupled with land use changes, the national food system in the Philippines is facing major threats from climatic changes. Approximately 20 typhoons affect the country every year, with increasing intensity expected in the future. The El Niño effect resulted in prolonged droughts in the 1990s, causing a retraction in national GDP due to a dramatic drop in agricultural production (Lasco et al., 2009). As the intensity of droughts and typhoons increase with climate change, the vulnerability of rural communities is likely to increase. The volume of water available in watersheds will change, causing flooding in rainy seasons and greater deficits in dry seasons (Lasco et al., 2009). The impact of climate change on the food system will come in the form of reduced yields, livelihoods, and resource availability (Lasco et al., 2009, 2016). Low-socioeconomic groups, largely comprised of food producers in coastal and inland areas, are the most vulnerable to changes in climatic conditions (Lasco et al., 2016).

Changing climates will likely reduce agricultural yields, increase the occurrence of heat stress in animals, and the incidence of pests and diseases (Lasco et al., 2016). Strategies for adapting to climate change in food systems remain largely targeted at protecting crops, rather than landscapes and people (Timmer, 2015). Consequently, food systems adaptation strategies have not been designed in a strategic and integrative way (Timmer, 2015). Given that 40% of the country's population remains in rural areas, mostly in agricultural landscapes (Philippine Statistic Authority, 2014b; UNDP, 2013), there is a critical need to build a knowledge base on how institutions can

integrate climate concerns into food systems policies and research. Climatic changes indicate that future food systems will require adaptation strategies to reduce the impact on production and rural communities.

The Philippines' unique biodiversity and vulnerability to a changing climate create a state of ecosystems that influences food systems activities and interventions. Localized food systems throughout the country, notably indigenous systems and specific case studies in the literature, report a microcosm of biodiversity-friendly agriculture (Carpenter, 2003, Rambo & Sajise, 1984; Wright, 2014). Although the majority of smallholder systems in the country work in intercropped systems, many policy and institutional incentives continue to be geared toward commodity production, marginalizing the importance of biodiversity and climate vulnerability contexts (Stone and Glover, 2016). The next section examines how historical colonial legacies influenced the current state of institutions in the Philippines, creating a national food system focused on key export commodities.

4.4 State of food institutions

The Philippines' agricultural system has a long tradition of producing for international markets, making the country a net food importer (Davidson, 2016). The dominant institutions established during the Philippines' occupation by Spain (1565–1899) and the US (1899–1941) determined, to a large extent, how land was used in the country. Since independence, a series of export-oriented programs and reductions in agricultural investments have stagnated the country's total food output (Davidson, 2016). Before Spanish colonization, forest cover was estimated to be 90%; in 2015, it was just 18%, largely as a result of timber production and agricultural activities (Wagner et al., 2015). Prioritizing staple market commodities has affected the social and policy contexts in which the current food system operates in two main ways. First, the favoring of cash crops in agricultural policies has reduced the focus on diversifying livelihood opportunities (Davidson, 2016; UNDP, 2013). Second, the lack of farmer agency (in terms of political and economic power) has meant that farmers are often the passive recipients of knowledge and extension services (Olabisi, 2011).

When the Spanish colonized the Philippines in 1565, they quickly realized the country's economic potential and began exploiting its vast forest resources (Bankoff, 2007). In the 333 years of Spanish colonial rule, it has been estimated that 25% of total forested land in the Philippines was cleared. The expansion of Manila and other urban centers created a demand for timber products for buildings, leading to the establishment of a coherent, well-structured and specialized timber trade system by the late 1800s (Bankoff, 2007). There was also increasing demand for domestically produced food products, resulting in agricultural expansion throughout the country and further clearing of the forests. Forested land that could be converted to agriculture was sold to elite Spanish families (Bankoff, 2007), laying the groundwork for the inequitable land distribution system that still operates in the country today. There was legal and political support for the economic activities that underscored deforestation during Spanish colonization and this continued under US occupation.

The US occupied the country in 1899. It took the US just 50 years to clear as much land as Spain had cleared in 333 years (Bankoff, 2007). The accessibility of the country's remaining forest cover, located within 120 km of the sea and with manageable topography, allowed for the expansion of timber as an export commodity to the US, Japan, China, and Europe. Land clearing was institutionalized; between 1900 and 1946, a range of public institutions were tasked with expanding the timber industry (Bankoff, 2007). Japan briefly occupied the Philippines between 1941 and 1945 and attempted to continue this trade in timber; however, external factors, such as the difficulty of procuring parts and securing good timber prices, prevented much timber production. When the Philippines became independent in 1946, approximately 50% of the country's forested land remained.

Under US occupation, the land ownership structures set up by Spain continued, as these facilitated the US's focus on commodity exports (Davidson, 2016; Borras, 2007). With the US as the primary importer, policy incentives and support for cash crops became the norm. Agricultural policy centered on supporting two major sectors: traditional and non-traditional. The traditional sector, which focused on corn, coconut, and sugarcane, continues to comprise 90% of total Philippine farmland (Borras et al., 2007; Davidson, 2016; Cororaton & Corong, 2009). The non-traditional sector focused on high-value crops, such as bananas, coconut, and pineapples (see Figure 12). Both agricultural sectors relied on smallholder farmers who worked land to which they had no legal title, and both sectors distributed the raw commodities to local and international private organisations and urban entrepreneurs (Borras et al., 2007).

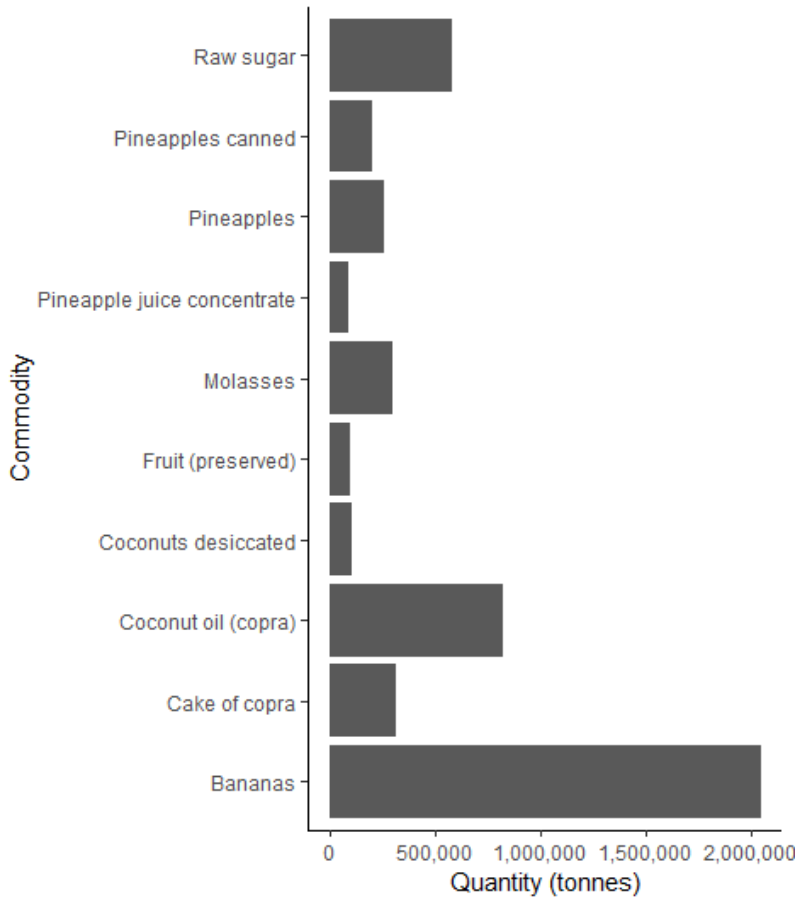


Figure 12: Top ten export commodities form the Philippines (based on FAO 2011)

The US Bell Trade Act of 1946, also known as the Philippine Trade Act, placed the US and elites in control of the majority of private businesses and cash crops grown in the Philippines for American markets (Maohong, 2012). US-owned sugar and coconut companies collaborated with elite Philippine landowners who exercised Western ideals of property rights. Political and institutional support for this type of landownership perpetuated the idea that informal smallholder and indigenous landownerships were illegal. The lack of recognition given to informal titles created opportunities for those who were legally and politically savvy to benefit from land laws, further pushing disadvantaged smallholders toward the margins. This lack of land rights, coupled with the ongoing need to produce food for export markets, created a system in which smallholders were laborers with minimal individual agency or power to influence policy processes (Borras, 2007).

A major factor that facilitated agricultural expansion in the Philippines after independence was institutional and political support for new technologies associated with the 'Green Revolution' (Davidson, 2016; Timmer, 2014, 2015). This led to the intensification of agriculture; a focus on specific commodities, including high-yielding varieties; and an increased use of external inputs (Kastner, 2009; Kastner and Nonhebel, 2010). This agricultural intensification prioritized key commodity production and failed to deliver positive nutritional outcomes for rural communities (UNDP, 2013). The establishment of the International Rice Research Institute in Los Baños is indicative of international efforts to provide agricultural technologies to the Philippines and the

broader Southeast Asian region (Stone & Glover, 2016) that effectively pushed indigenous and smallholder production knowledge systems to the margins and prevented them from diversifying their production practices (Coxhead, 2000).

As the population in rural areas increased, agricultural land ownership and reforms became a core concern for Philippine governments. Maohong (2012, p. 123) stated that since independence "virtually every president promulgated agrarian reform programs." Policies such as the Magna Carta of Small Farmers (Government of the Philippines, 1992) and Framework for the Right to Adequate Food (Government of the Philippines, 2014) represent political visions to achieve food security and social development. Yet, these have not been realized, largely because elites continue to hold greater power than smallholder farmers and continue to drive a highly industrial agricultural system (Borras, 2006, 2009; Franco & Borras, 2007). The reality is that most smallholder producers lack formal land entitlements and risk being dislocated to make way for other land uses if they complain. The disjointed implementation of land reform and tolerance of corruption have amplified the negative impacts of land policies, thus perpetuating underdevelopment in rural areas (Lockie et al., 2012).

4.5 State of food discourses

This complex history of commodity production and environmental change in the Philippines has led to two visions of improving food security, which, as Lockie (2005) has observed, are driven by different understandings of what food security means and how this translates into action. This has resulted in debate between the two main discourses that are seen as drivers of food and nutrition security outcomes (Jarosz, 2014; Leventon & Laudan, 2017): food security and food sovereignty. Both discourses present different ways of framing food systems interventions (Chaifetz & Jagger, 2014; Jarosz, 2014; Smith et al., 1992). Given the export policy context of the Philippines, the discourse of food security is concerned with providing access, availability, stability, and utilization of food to meet dietary needs. Framed as an economically oriented discourse, market food security ignores issues of social interactions, equity, gender, and environmental concerns (Jarosz, 2014). By contrast, the discourse of food sovereignty focuses on the rights of rural communities to frame and influence their immediate food systems. Both discourses operate in parallel; food security is generally aligned with large-scale interacting food systems and food sovereignty is often associated with localized systems (Leventon & Laudan, 2017)

The historical context of the Philippine food system has been oriented toward high productivity and international markets (Lockie, 2005; Lockie et al., 2012). In terms of policy, Philippine food security is largely defined as existing when there is domestic self-sufficiency of key commodities, especially rice (Davidson, 2016; Timmer, 2014, 2015). This self-sufficiency poses geopolitical challenges for the region, which continues to pursue economic integration and neoliberal trade ideas (Desker et al., 2013). Moreover, the framing of food security as self-sufficiency in staple commodities limits the opportunity to reframe solutions that draw from diverse knowledge types on different production systems, such as those that exist among Philippine rural communities. For

example, the use of participatory approaches (such as farmer field schools) can enable learning and observation of context-specific challenges that are often marginalized from macroeconomic narratives (Daniel *et al.*, 2014). Evidence from the Philippines shows the contribution that diverse knowledge systems can make to agricultural practices, especially at localized levels, which is where farmers and agricultural extension officers often interact (Carpenter, 2003, 2010; Wright, 2014).

The discourse of food sovereignty presents alternative ways of conceptualizing food activities and embracing diverse knowledge types. Food sovereignty is understood as the right of people and nations to control their own food systems, including markets, production models, food cultures, and environments (Wittman et al., 2010). The scale of food sovereignty is often local—communities can influence their production and consumption practices within specific legal and environmental settings (Cuevas et al., 2015). The discourse of food sovereignty sheds light on the economic and power structures that influence rural development (Chaifetz & Jagger, 2014; Wittman et al., 2010). Food sovereignty activities have a strong presence in the Philippines; farmer movements have been advocating for justice, equity, and greater control over land for decades (Borras, 2006). There has also been considerable research on food sovereignty in the Philippines, including studies into the role of elite landownership and the disempowerment of farmers (Borras et al., 2007; Lockie, 2005; Lockie et al., 2012). Research focusing on smallholder agency and decision-making has highlighted the possibilities offered to diverse production systems and village institutions that empower farmers (Carpenter, 2003; Wright, 2014). Food sovereignty language is also present in national government documents. However, despite employing the language of farmer participation, there is little evidence of how (or whether) these documents are applied in rural areas. As Habito and Briones (2005) noted:

> *It is often remarked that the Philippine government has no shortage of good plans and programs to address various sectoral concerns, like those of the agricultural sector. It is, however, in the implementation of such plans and programs where the failures lie.* (p. 12)

Like food security, food sovereignty is understood differently by different actors. This increases the level of tension and debate between food security and food sovereignty discourses (Chaifetz & Jagger, 2014; Jarosz, 2014) and provides the opportunity for human ecology scholarship to analyse social drivers in food systems.

4.6 Discussion

The material presented above makes two contributions to analysis of the social drivers in food systems: first, it shows the complex history of land use in the Philippines at a macroeconomic level, and the implications of this for current environmental and social systems; second, it demonstrates how human ecology is a useful tool for capturing dominant discourses and the possible alternatives. In this discussion, I apply the material presented above to produce an overview of the current state

of the human ecology of the Philippines' national food system. The feedback links are numbered and presented in the text with an "L" followed by the respective number.

4.7 Maladaptive feedback processes in the Philippines

Figure 13 synthesizes the literature analysis into the human ecology framework; each feedback processes is explained in Table 4. The analysis shows the tendency for public institutions to focus on the production of key commodities in the pursuit of economic growth (Coxhead et al., 2001; Davidson, 2016), presented here as the variable "extent of commodity intensification policies." This continues to be a dominant position in domestic agricultural policy in much of Southeast Asia, including the Philippines (Timmer, 2014, 2015; Habito & Briones, 2005). This dominant focus has created a food system that is unable to achieve the outcome of food and nutrition security in which there is a stable supply and economic access to safe and nutrition food for the population (Coxhead, 2000; Davidson, 2016). This has led to inequitable health outcomes and low incomes in rural areas (Bankoff, 2007; UNDP, 2013; Zamora et al., 2013). L3 in Figure 13 shows how farmer incomes remain consistently low as policies maximize the production of key commodities, eroding any income diversification opportunities. Forest cover continues to decline as land use expands to produce cash commodities, as shown by L5 in Figure 13. The dominant discourse that prioritizes cash commodities as the main output drives the system's behaviour (L1). Processes are explained in Table 9.

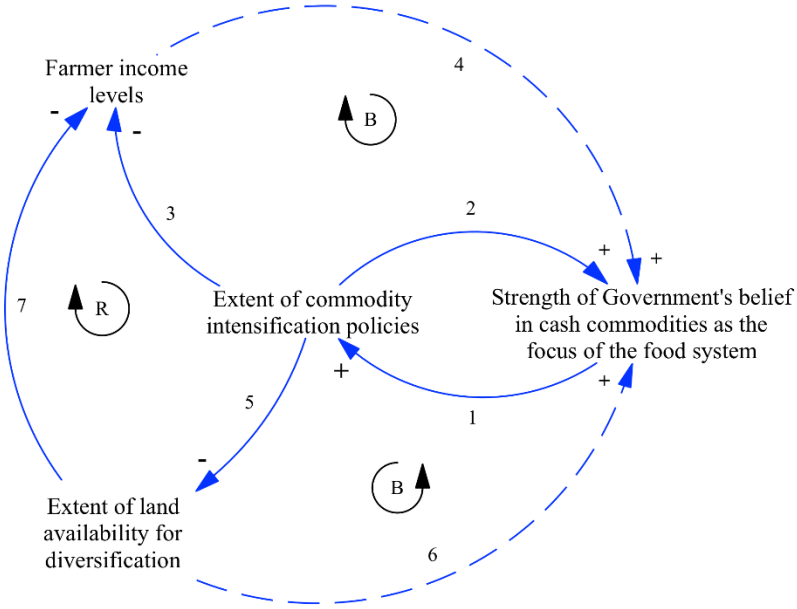


Figure 13: Human ecology of the Philippines' dominant food system

Table 9: Explanation of links from Figure 13

Link Number	Process represented by the links in Figure 13
1	This link is positive. Historical influence has created a policy orientation to increased productivity; this demonstrates the strength of the government's belief in commodities.
2	This link is positive. Observations of declining agricultural productivity during the last two decades have led to the strengthening of institutions charged with enacting intensification policies.
3	This link is negative. As intensification efforts go up, farmers' incomes go down. Rural incomes are vulnerable to market and environmental shocks. Poor nutrition outcomes are representative of the negative state of health and wellbeing.
4	This link is positive but weak. If farmers' incomes went up, this would reinforce the government policy. However, incomes are going down. This should drive policy in the same direction. Falling farmer incomes ought to cause government to change its stance, but it does not. This represents the weak sovereignty farmers have over policymaking processes.
5	This link is negative. As the policy of commodity intensification goes up, the behavioural response is the activity of land clearing, which results in the amount of forested land area going down. The state of this variable is currently 18% of land cover and falling.
6	This link is positive, but weak. If forest cover were to increase under commodity intensification programs, that ought to drive policy in the same direction (i.e., strengthen it). In fact, forest cover is going down, so that ought to weaken the policy. Forest loss can lead to erosion and biodiversity decline, which has been documented to hinder long-term agricultural sustainability.
7	This link is negative. As farmers have few options to try to escape their commodity trap other than to expand areas of production to increase total volumes, any effort to increase forest cover would negatively affect their income. The consequence is ongoing farmer efforts to clear forest cover as one of few strategies left to them to increase their income. Eventually, farmers will be negatively impacted by this strategy as ecosystem services are lost. Farmers may be aware of this, but the short-term demands of their immediate perilous state of wellbeing do not give them the luxury of taking this longer view into account.

In Figure 13, all feedback processes feeding into the dominant state of discourses are positive (L2, L4, L6), amplifying the variable as the system behaves. For example, L2 presents a positive feedback that has been created by dominant historical land use activities, policies, and ownership laws in the Philippines (Borras, 2006; Cororaton & Corong, 2009; Davidson, 2016; Desker et al., 2013). As policies for key commodities develop to balance international trade with domestic self-sufficiency (Desker et al., 2013), the dominant discourse of commodity production is perpetuated (L1). Figure 3 emphasizes the dominant systemic behaviour driven by market-oriented food security policies (L1 and L2 feedback). This dominant discourse confirms research that contends that a market-oriented focus prevents alternative discourse and knowledge types from being included in food system activities (Clapp, 2015; Jarosz, 2014; Rivera-Ferre, 2012; Wittman et al., 2010). Human ecology analysis shows the challenges for intervening in a system that has failed to deliver human and environmental wellbeing. Sustained land degradation has been the product of the dominant discourse influencing behaviours and institutions, and a national discourse of food sovereignty focused on self-sufficiency will only perpetuate the system's behaviour. The feedback processes

create a maladaptive system that is unable to break from dominant patterns. This can have long-term implications for sustainability; for example, it is common for food decision-making institutions to be trapped in maladaptive cycles that prohibit new ways of framing problems and prevent solutions from emerging (Termeer et al., 2018), despite efforts to change such behaviours.

An example of this maladaptation and the implications for food system outcomes is shown by the negative links between commodity production on household incomes (L3) and forest cover (L5). This is represented by L3; increased policy support for key commodities make farmers reliant on traders to supply agrochemical inputs and on commodity prices to secure incomes, which limits their capacity to come out of poverty (Davidson, 2016; Reyes et al., 2012). Increasing commodity prices will continue to act as signals for policies to transition from diverse commodity production systems to intense monocropped agricultural systems, often at the cost of local ecosystems (Cramb et al., 2009; Dressler et al., 2016). Philippine ecosystems provide biodiversity and services that continue to decline in abundance and heterogeneity as commodity production expands (L5) (Posa et al., 2008; Wagner et al., 2015). Continued reduction in agrobiodiversity presents barriers for sustaining household food consumption diversity, which can have negative long-term nutritional and environmental effects (Frei & Becker, 2004; Zamora et al., 2013). The economic benefits likely to be generated from expanding cash commodity trades are unlikely to filter down to smallholder farmers as their landscapes continue to degrade, as shown in L7 (Borras, 2006; Borras, 2007). The experience of land conversion in the Philippines is similar to other Southeast Asian rural economies, in which cash commodities have degraded local knowledge and agrobiodiversity (Carpenter, 2003; Cramb et al., 2009; Dressler et al., 2016; Stone & Glover, 2016). The dominant system is "trapped" in maladaptive behaviour. However, the "weakness" of some feedback processes suggest possible points of intervention; these are documented across different small-scale food systems in the Philippines.

There are possible intervention points in the current maladaptive system presented in Figure 3, highlighted by the "weak" feedbacks in L4 and L6. Weak feedback processes can be used as leverage points to influence the behaviour of a system toward more sustainable human and ecological outcomes. Such leverage points exist in L4, which, as it stands, sees small links between the ability of farmers to influence policy and the dominant market-oriented discourse. The second, L6, shows the current system in which policies addressing the link between commodity production and forest loss have been delayed. Both of these feedback processes are in transition, with multiple activities from localized food systems, research approaches, and new policy developments pointing to ways of reframing the dominant market discourse.

An example of a leverage point comes from documented experiences in specific landscapes where alternative food production practices have challenged the dominant discourse. For example, there are extensive context-specific case studies that adapt practices to improve human and environmental systems through agroforestry, intercropping, organic practices, and participatory farmer learning activities (Carpenter, 2003, 2010; Frei & Becker, 2004; Salazar, 2013; Sahakian et

al., 2017; Rambo & Sajise, 1984; Wright, 2014). Lessons from alternative practices demonstrate the critical role that formal farmer governance systems, such as cooperatives and organisations, play in creating opportunities for influencing current policy systems (L4) (Carpenter, 2003, 2010; Wright, 2014). Policy support for alternative practices is also emerging as a response to environmental degradation (L6). For example, there is rapid growth in organic practices as well as national policy requirements to have 5% of land cultivated under organic production (Sahakian et al., 2017; Salazar, 2013). Although organic production faces similar risks of monoculture and input dependency as industrial systems, there is growing recognition of the need to address environmental impacts in Philippine agriculture in light of growing population pressures, environmental change, and regional trade agreements (Depositario & Saguiguit, 2014; Desker et al., 2013; Sahakian et al., 2017; Salazar, 2013). Equity issues, such as including marginalized farmer voices in governance processes (L4), are also growing in recognition through focusing on the sovereign right to food among the Philippine population (Government of the Philippines, 2014). Human ecology analysis provides insights into feedbacks in which alternative perspectives and approaches could shift current maladaptive behaviours. The application of the framework has provided a systems-based foundation to explore the role of dominant discourses in specific contexts. This foundation provides a template for expanding human ecology studies, thereby contributing to the growing use of social science approaches in food systems.

4.8 Human ecology and food systems

This analysis shows that human ecology is a useful tool for advancing studies into the social drivers influencing food system behaviour. Given the complexity of food systems, it is important to understand how specific case studies are linked with regional governance and environmental changes (Ingram et al., 2010). The human ecological analysis conducted here shows how focusing on a country informs possible policy and research interventions based on the underlying food discourses. Human ecology and food systems are conceptually compatible, as they share underlying dynamic system principles that inform mixed methods and facilitate multistakeholder knowledge brokering activities. This makes human ecology a useful framework for studying how different food system actors understand food and nutrition security challenges, and for identifying possible intervention points to change the system's behaviour.

Human ecology offers a way of capturing how the issues across four core sustainability variables are connected through feedbacks. The framework highlights a specific problem as a symptom of the feedback processes in the system, and provides opportunities to intervene where weak feedbacks exist. The application to the Philippines shows how the maladaptive nature of the system has evolved through time, and provides a snapshot of possible intervention points. The application of the framework to the Philippines—and, in fact, any other national case study—offers insights into broader discussions into the complexity of governing food systems across different scales (Candel, 2014; Leventon & Laudan, 2017). The systems foundation of human ecology, as

presented here, is shared with both the food systems framework and emerging tools for analyzing the social and political aspects of food governance (Leventon & Laudan, 2017; Termeer et al., 2018). Scholars' contributions toward food governance research (Candel, 2014; Hospes & Brons, 2016; Termeer et al., 2018) present opportunities for human ecologists to use systems-based analysis to identify the influence of dominant discourses in different food systems.

In food systems research, there is increasing recognition of the value of conducting activities that are designed with locally relevant stakeholders to capture the different discourses and proposed solutions in a food system (Marin et al., 2016; Rivera-Ferre, 2012). Transdisciplinary research agendas based on systems approaches are growing; these require collaborative efforts and expertise that link up the multiple stakeholders concerned with particular problems. The overwhelming complexity of the social drivers of food systems can be managed by using human ecology to both guide stakeholders to explain how they perceive food insecurity challenges and build shared understandings of challenges across disciplines and sectors (Davila & Dyball, 2017). This can guide the identification of competing ways of framing food challenges and contribute toward documenting novel transdisciplinary research approaches in food systems (Marin et al., 2016). Given the tensions that exist between localized food sovereignty discourses and the institutionalized market food security approaches that dominate food governance across different scales, such an approach is crucial (Candel, 2014; Leventon & Laudan, 2017).

In future systems-based food policies, human ecological analysis can help practitioners to critically reflect on how institutional and governance responses have contributed, or not, to human and environmental wellbeing in food systems. Feedback guided analysis across different variables can help to identify situations in which policies have led to unintended outcomes, and leverage from possible weak feedbacks to experiment with changes. This will require novel governance arrangements that allow institutions to learn and intervene. Food will play a major role in delivering global sustainable development goals (Rockström et al., 2016), indicating the need to develop novel ways of investing, managing, and governing food to balance human and environmental wellbeing.

4.9 Conclusion

This paper has demonstrated how human ecology helps to identify the dominant discourses that influence the social drivers in a food system. Human ecology in the Philippines has a strong history of exploring the role of humans in agricultural landscapes, and has recently re-emerged as a systems-based approach for contributing to regional visions of transdisciplinary research (Rambo, 1983; Rambo & Sajise, 1984; SEARCA, 2014). This makes the analysis presented here timely, as it contributes to the growing use of systems-based approaches to capture the underlying discourses that influence human behaviour and their impact on sustainability. The complexity of food systems requires tools that share the same foundations and systems principles, but are able to capture how different social systems interact with their food environments. Ongoing applications and testing of

human ecological analysis in different contexts will enable comprehensive food systems programs to emerge across different scales, linking and training future leaders in food systems management.

In the Philippines, food security—framed as self-sufficiency in terms of key commodities and achieved by maintaining exports—has presented limitations for diversifying and expanding smallholder and indigenous production systems. Smallholder farmers have failed to benefit from the economic gains made in the agricultural sector, with degraded landscapes, complex land entitlements, and the high cost of commodity production reducing opportunities for poverty reduction. Documented alternative production systems exist; these are driven by farmer organisations and cooperatives that seek to change the way that maladaptive policies influence localized food systems, offering possible pathways for improving environmental and human wellbeing.

The framework used here is limited, as it does not focus on power dynamics and their influence in food systems behaviour. Further exploration of these unequal distributions of power and understandings of different ways to improve food security is critical. The framework implemented in this paper offers a step toward capturing the discourses that influence the state of a system. Future applications of human ecology need to be more cognizant of how the discourses are understood and applied by different actors in food systems, and the potential implications of this on power relations in specific food systems. Human ecology, as presented here, provides a systems-based analytical tool for identify the competing discourses in a specific food systems and their influence on the system's behaviour. Ongoing use of the food systems framework will benefit from detailed studies of human and ecological change in the context of interacting discourses, ultimately bridging disciplines and providing policy insights to address food insecurity and work toward sustainable food systems.

Chapter 5: Transdisciplinary research for food and nutrition security

Full reference: **Davila, F.** Dyball, R. Amparo, J.M. 2018. Transdisciplinary research for food and nutrition security: Examining research-policy understandings in Southeast Asia. *Environmental Development.* 28, 67-82.

Status: Published in 2018

So far, I have presented two theoretical chapters in which I used the human ecology systems-based framework to explore market food security and food sovereignty in food systems literature and in the context of Philippines export oriented agricultural institutions.

As per Table 1 in Section 1.6, in this chapter I contribute towards the thesis question: *What discourses exist among policy and research groups responsible for food and nutrition security activities?* I document a systems-based process for capturing shared understandings of food and nutrition security challenges. Throughout the chapter, I argue that this shared understanding acts as a step towards collective communication between policy makers and researchers tasked with participating in future transdisciplinary programs. The chapter provides empirical material on the use of the human ecology framework in a workshop context, and the findings are situated in the broader context of my overall doctoral contributions in Chapter 8.

5.1 Introduction

Research and policy programs to improve food and nutrition security whilst reducing environmental harm are core to the Sustainable Development Goals (Rockström *et al.*, 2016). Feeding the world sustainably requires approaches that focus on how different stakeholders frame challenges and solutions in light of global environmental changes (Rivera-Ferre, 2012). These environmental changes will influence how institutions and researchers design food and nutrition security policies and programs (Marin *et al.*, 2016). In such circumstances, knowledge generated from traditionally disciplinary studies will face challenges in influencing the complex policy systems that govern food and nutrition security through narrowly framing problems (Candel and Pereira, 2017; Thompson and Scoones, 2009). To overcome this, transdisciplinary research has emerged as a way of conducting research between academics, policy-makers, communities and other stakeholders in order to practically implement solutions to complex problems (Lang *et al.*, 2012; Newell and Siri, 2016).

Transdisciplinary research addresses issues of societal and environmental importance, and fosters the integration of disciplines and knowledge produced by academia and broader societal actors (Blythe *et al.*, 2017; Lang *et al.*, 2012). Bringing together different stakeholder understandings at the early stages of program and policy developments can help identify contested perspectives and provide tools for building a shared sense of purpose and envisioning new solutions (Blythe *et al.*, 2017; Newell, 2012; Newell and Siri, 2016). Yet while differences in the framing of complex problems between researchers and policy-makers are widely discussed in the literature (van Kerkhoff and Lebel, 2015), only recently approaches focusing on environmental and social interactions in food systems have gathered momentum within transdisciplinary studies (Hammond and Dubé, 2012; Horton *et al.*, 2017; Marin *et al.*, 2016). We contribute to the growing need to build systems-based understandings of food and nutrition security through documenting how researchers and policy makers from four Southeast Asian countries perceive challenges and solutions for addressing food and nutrition security in their chosen food systems. We use systems diagrams to discuss implications for future transdisciplinary research targeting food systems theory and practice.

Burgeoning theory and practice on transdisciplinary research offers opportunities to bring together diverging understandings of problems to produce transformational knowledge (Lang *et al.*, 2012; Roux *et al.*, 2017). The explicit concern of transdisciplinary research for integrating diverse knowledge types enables an 'extended peer community' to debate and propose novel interventions to a problem (Ravetz, 2006b). Developing such peer communities requires stakeholder identification processes, expert facilitation, and training on the co-design of research to address a 'real world' problem, conduct it collaboratively, and disseminate results in an appropriate manner (Lang *et al.*, 2012; Page *et al.*, 2016; Roux *et al.*, 2017). Such approaches contribute to: identify root causes of sustainability problems (Abson *et al.*, 2017), identify conflicting values and uncertainty in light of

urgent decisions (Ravetz, 2006b), and link sustainability with the political, historical, and economic trends that influence environmental change (Lövbrand *et al.*, 2015). Transdisciplinary research offers a way of identifying solutions to complex problems that transcend boundaries and disciplinary knowledge systems (Rasul, 2016; Stafford-Smith *et al.*, 2016). To advance transdisciplinary research, there needs to be documented case studies that have underlying structural similarities so that knowledge can be applied in other contexts as new policy and research developments occur (Adler *et al.*, 2018; Magliocca *et al.*, 2018).

In this paper, we document a systems-based process for capturing shared understandings of food and nutrition security challenges as a step towards collective communication between policy makers and researchers tasked with participating in future transdisciplinary programs. We conducted a workshop with Southeast Asian researchers and policy makers to identify what they understood as the nature of food insecurity problems, what interventions they thought would improve these problems, and what they saw as the relationship between those involved in creating change. The workshop's aim was to gain insight into the participants' dominant understandings of pertinent issues and key agents involved, not to critique or verify their views. To do this, we used a systems framework and diagramming process to capture schematic representations of the key challenges to food and nutrition security that they identified. The use of a human ecology systems-based method helps capture the often-conflicting perspectives and values held by different individuals and groups (Dyball and Newell, 2015; Jarosz, 2014; Newell and Siri, 2016; Rivera-Ferre, 2012; Salas-Zapata *et al.*, 2013). This is a crucial precursor step to the collective pursuit of common goals, including sensitive cross-cultural learning from successes and failures in one regional context for another. For language clarity, in Table 10 we present how we defined core concepts used to inform the design, conduct, and analysis presented in the paper.

Table 10: Core concepts used in this study

Systems thinking	A quantitative or qualitative way of designing, collecting, and analysing data that focuses on variable identification and the positive and negative feedbacks between them. Systems thinking allows abstraction from specific cases to broader themes relevant to larger scale systems (Meadows, 2008; Newell and Siri, 2016).
Food systems	An overarching way of understanding links between food activities, such as production, packaging, and distribution, and food outcomes, such as food and nutrition security. Environmental change and socio-political systems heavily influence food systems' behaviour (Ericksen, 2008a; Ingram, 2011a; IPES Food, 2015) .
Food and nutrition security	A normative objective that delivers physical, social, and economic access to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life (FAO, 2017)[8].
Transdisciplinary research	Addresses issues of societal and environmental importance, and fosters the integration of multiple disciplines and knowledge systems beyond academia. A focus on co-production and impact is core to research design (Blythe *et al.*, 2017; Lang *et al.*, 2012).
Human ecology	A framework for guiding analysis into the feedbacks between humans and their environments (Davila and Dyball, 2018; Dyball and Newell, 2015; Rambo, 1983).

In the next section, we present the transdisciplinary food systems and regional focus of this study. We then present an integrative human ecology systems-based framework that helps connect dominant discourses, institutional activities, human wellbeing, and ecosystem changes. We then provide an overview of the workshop activities for capturing a shared understanding from 18 participants from four countries: Cambodia, Lao People's Democratic Republic (PDR), the Philippines, and Thailand. We present the country specific systems diagrams and the dominant ecological, social, and institutional drivers of change as perceived by participants. We discuss how these research and policy perceptions provide leverage points to design alternative agricultural interventions that involve farmers as agents of change, and the implications of the systems framework for future transdisciplinary food systems research.

8 Extensive critiques of the language of food and nutrition security can be found elsewhere (Carolan, 2016; Davila and Dyball, 2018; Pinstrup-Andersen, 2009; Rivera-Ferre, 2012; Smith *et al.*, 2017a).

5.2 Transdisciplinary food systems context

Transdisciplinary food systems research is one that explicitly embraces diverging knowledge types, interests, and uses a diversity of methods to reveal new knowledge on how to achieve food and nutrition security (Francis *et al.*, 2008; Hammond and Dubé, 2012). Food and nutrition security is affected by a series of value chain activities, policy and political institutions, market drivers, environmental change, and cultural systems (Barling and Duncan, 2015; Fanzo, 2014; Ingram, 2011a). These activities interact through feedbacks between producers, processors, distributors, retailers, and end consumers (Ericksen, 2008a; Ericksen *et al.*, 2010; Rockström *et al.*, 2016). Early food security research and policy failed to capture the systemic nature of food security, focusing on either biophysical or economic dimensions of the problem, and omitting the wider social equity and environmental challenges associated with food activities (Ingram, 2011a; Lee, 2012). This created a tendency to measure economic access, prioritising trade of staple commodities, and marginalized broader cultural and environmental concerns (Clapp, 2015; Ingram, 2011a; Westengen and Banik, 2016). This meant that wider interacting system variables affecting food security, such as natural resource management, rural community wellbeing, and consumer health effects of nutritional changes, were under-emphasised in productivity and global trade focused policies (Clapp, 2017; Lee, 2012). These feedbacks between social and environmental variables in a food system (Ingram, 2011a), and the competing institutions and stakeholders (Barling and Duncan, 2015; Carolan, 2016), make food system challenges inherently transdisciplinary (Hammond and Dubé, 2012).

If current consumption and demand patterns continue in Southeast Asia, food production will need to increase by up to 70% from 2000 levels by 2050 (Msangi and Rosegrant, 2009). Much of these productivity increases are expected to come from the region's agricultural landscapes, which are still largely managed by smallholder farmers and are highly vulnerable to environmental change (Lowder *et al.*, 2016; Wahlqvist *et al.*, 2012). These farmers are facing the growing impacts of climate change, limited access to education, and ongoing poverty, while a lack of local policy and effective government support often prevents food and nutrition security from being achieved (Timmer, 2014; Timmer, 2015; Wahlqvist *et al.*, 2012). Historically, Southeast Asian policy support has transitioned from agro-biodiversity rich farming approaches towards highly mechanised, high input and core commodity production systems, largely framing food challenges as one of food availability and economic access (Borras, 2007; Borras and Franco, 2005; Cramb *et al.*, 2016; Wahlqvist *et al.*, 2012). In the Philippines, the long-standing food security policy focus on agricultural cash commodities has had social and environmental consequences (Sahakian *et al.*, 2017). Deforestation and social inequality has been the product of a focus on core staple commodities for global markets, such as sugar, timber, and palm oil (Cramb *et al.*, 2016; Davila, 2018). For Southeast Asia, the narrow framing of food and nutrition security solutions within a market framing ignores broader critical issues in sustainable development (Jarosz, 2014; Rivera-Ferre, 2012; Wahlqvist *et al.*, 2012). The focus on market availability of food means that environmental degradation, gender and family equity, power relations, and land rights remain in the

margins of policy and disciplinary focused research (Cramb *et al.*, 2016; Depositario *et al.*, 2015; Lang and Heasman, 2004; Lee, 2012).

To address narrow framings of food solutions, regional research agencies pioneering systems-based and transdisciplinary approaches can play a role in informing future food policies and programs. The Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA) is an example of an agency that both reflects and defines how understanding of market focused food security has evolved over the last fifty years in the region (Depositario *et al.*, 2015; Depositario and Saguiguit, 2014). Despite Southeast Asian calls for the inclusion of human behaviour and environmentally-focused rural development research from the early 1980s (Rambo, 1983; Rambo and Sajise, 1984), the political economy and dominant disciplinary perspectives of researchers inhibited SEARCA from framing food security in a broader context (Depositario *et al.*, 2015; Depositario and Saguiguit, 2014). Recently, SEARCA has made a commitment to break out of this narrow tradition of understanding through the launch of their Integrative and Sustainable Agriculture for Rural Development (ISARD) strategic plan. ISARD seeks to engage multiple stakeholders in research design and conduct as a means to improve the environmental and human wellbeing outcomes in rural landscapes (SEARCA, 2014). ISARD investments will be focused on transdisciplinary projects that link disciplines, actively engage different stakeholders, and use concrete systems-based theoretical frameworks. This is intended to facilitate the identification of dominant narratives, reveal feedback between variables, and encourage co-designed research between researchers, public organizations, businesses and smallholder farmers (Depositario and Saguiguit, 2014). This provides an opportunity to link SEARCA's initiatives (Depositario and Saguiguit, 2014) with innovative transdisciplinary frameworks such as human ecology (Davila and Dyball, 2018; Dyball and Newell, 2015) and sustainability science (Kauffman and Arico, 2014), ultimately influencing policy and institutions to tackle sustainable development challenges in a holistic way (Rasul, 2016; Stafford-Smith *et al.*, 2016). To generate this influence, there needs to be a general understanding and reflection on how food systems challenges are framed before proceeding with transdisciplinary activities (Marin *et al.*, 2016; Rivera-Ferre *et al.*, 2013).

5.3 Human ecology systems framework

We selected a human ecology systems framework (Davila and Dyball, 2018; Dyball and Newell, 2015), because it enables a holistic and comprehensive analysis of complex human-environmental systems and captures the dynamics of change driven by feedback processes (Figure 14, Table 11). Ostrom (2010 p:5) states that the role of broad conceptual frameworks is to 'organize diagnostic and prescriptive inquiry and provide a general list of variables that should be used in analysis'. Systems oriented frameworks are useful for progressing sustainability science, as they help identify feedbacks between environmental and social variables in a system (Fischer *et al.*, 2015; Newell and Siri, 2016). They are also able to diagnose possible underlying root discourses and institutional structures that inhibit or enable change (Abson *et al.*, 2017; Dyball and Newell, 2015;

Meadows, 2008; Midgley, 2000). As a framework designed to enable transdisciplinary enquiry, human ecology offers a chance to practically explore shared understandings between individuals and groups who are intending to collaborate on common issues, but who come from diverse cultural or sectorial backgrounds (Brown *et al.*, 2010).

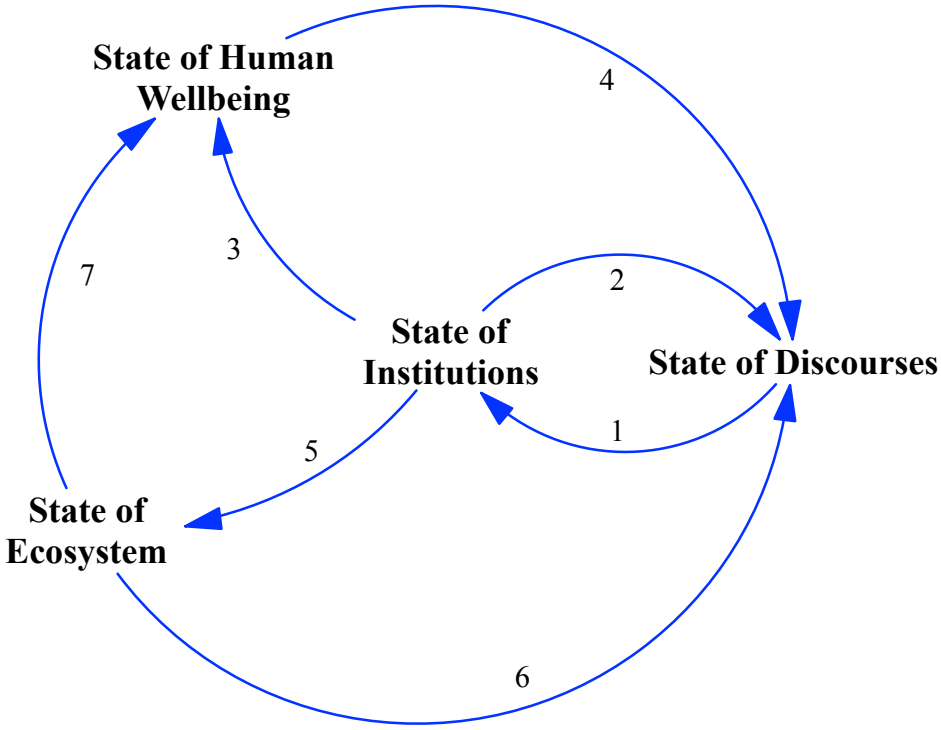


Figure 14: The human ecology framework, based on Dyball and Newell (2015)

Table 11: Processes in the human ecology framework

Arrow number	Process described by the arrows between variables
1	The influence that a dominant discourse has on generating formal and informal decisions amongst individuals or institutions. This includes planning and goal setting resulting in the design and implementation of policies to promote the dominant discourses in society.
2	As formal and informal institutions learn from experiences, they will either reinforce or change the dominant discourse. Dominant discourses may change or resist change, as other institutions might reinforce it. If they were changed, they would influence the formation of new institutions to reflect the new discourse.
3	This link shows the implications of institutional decisions on individual or community's physical and psychological wellbeing.
4	As communities and individuals change based on institutional activities, dominant discourses may shift, eventually creating new institutional interventions. As with L2, these observations may challenge or reinforce core values, depending on circumstances.
5	This includes collective activities promoted or enabled by dominant social institutions that directly affect the environment.
6	As ecosystems change based on formal and informal institutional activities, new discourses may emerge or dominant discourses perpetuated.
7	Ecosystems are affected by policies and human behaviour, and as ecosystems change they directly affect human health and wellbeing.

Human ecology is compatible with other sustainability oriented frameworks and methods. Socio-ecological systems and co-production theories also focuses on human-environment linkages and how knowledge processes take place in different contexts (Fischer *et al.*, 2015; Miller and Wyborn, 2018). In resilience thinking, the focus on quantifiable change and abstract human behaviour enables the study of how human and environmental systems are able to cope and absorb change (Walker and Salt, 2006). Qualitative methods can capture multi-stakeholder designed solutions, and can be coupled with quantitative methods to conduct novel transdisciplinary food systems research (Hammond and Dubé, 2012; Ingram, 2017). Back casting and visioning methods are powerful tools for problem framing and identifying ideal futures that can be worked towards though careful strategy design (Wiek and Iwaniec, 2014; Wiek and Lang, 2016). Human ecology systems methods do not seek to verify or refute specific claims, but rather to see how different groups perceive, understand, and value food systems change. This can guide analysis of how these perceptions align with broader issues debated in food systems policy and research.

We used the framework qualitatively to identify dominant perceptions of food and nutrition security from workshop participants, as they were tasked with drawing systems diagrams of their food system of interest. The systems thinking method creates a visual representation of how a group of experts share the understanding of a particular problem. These visual representations are heuristic devices intended to convey individual and group mental schemas of the problems situation, not to

be working models of it. As such, they are not necessarily verifiable, being neither right nor wrong. They are intended to reveal the different beliefs and priorities and to let participants see 'where each other are coming from' and to form the basis for the constructive development of a shared understanding. This shared understanding relates to the extent to which participants share common concepts and meanings through which communication and mutual comprehension is possible and is crucial if coherent collaboration is to be possible (Newell and Siri, 2016). In such circumstances, it is useful to encourage individuals and groups to label variables and processes that are unique to their specific system of interest in terms that are relatively simple and generic. By avoiding highly context-specific terms or technical jargon, people from dissimilar backgrounds are more likely to find common ground for mutual comprehension. This type of framework aids thinking in food related sustainability science, as it captures how different individuals understand the challenges and opportunities in food systems.

The framework involves clustering empirical observations within four major sustainability variables relevant to sustainability challenges (Dyball and Newell, 2015). The four variables and their relevance are:

- *State of discourses:* This refers to the collective ideas in individuals or groups that influence action. Discourses may not be shared equally (Dryzek, 2007), but the framework draws attention to those that are dominant and most responsible for a system's behaviour. At the same time, the framework can reveal alternate discourses that are currently marginalized or oppressed but which, if empowered, could set different goals for the system.
- *State of institutions:* This represents the dominant social institutions that the community has established to govern their collective behaviour. These are the formal and informal rules and institutions that facilitate a community's actions. Formal institutional rules manifest as policy instruments, such as taxes, regulations, and education programs. Informal institutional rules are those tacit regulations that influence what a community judges to be appropriate conduct in the circumstances (Fischer *et al.*, 2012).
- *State of ecosystem:* This includes both the natural environment and anthropogenically constructed artefacts, such as agricultural landscapes, buildings, roads, and vehicles.
- *State of human wellbeing:* This captures all physical and psychosocial aspects of what it means to live well. This includes indicators of good health, such as adequate nutrition.

The arrows in Figure 14 are feedback processes or activities that influence, positively or negatively, the meta-variables. The framework offers a way of analysing discussions and diagrams developed in qualitative workshop activities in a way that draws links between variables. The framework also enables researchers to link empirical findings with wider discourses and themes present or missing in the diagrams. The framework is limited by not explicitly outlining issues of power relations, which play an important role in how food is governed. This limitation is remediated by the fact that the framework allows participants to identify how they perceive a system, and when

used analytically, those using the framework can look at what is missing or omitted from the dominant understandings.

5.4 Method for a shared understanding: A systems-based workshop

Eighteen (18) participants took part in the one-day workshop in June 2015, facilitated by staff from the Australian National University and the University of the Philippines, Los Baños. The participants were purposefully selected by the research team and SEARCA as future leaders of the ISARD program and therefore central to the development of transdisciplinary programs in the region. Workshop participants included university researchers and local government representatives from Cambodia, Laos, Thailand, and the Philippines. This workshop formed part of the initial phase of the co-design of longer-term transdisciplinary endeavours in the region. Each of the selected countries face major food and nutrition security challenges in urban and rural contexts (Table 12) ranging from food availability (Cambodia and Laos) to nutritional quality of available food (Thailand and Cambodia). The participants are heavily involved in transferring research to applied agriculture contexts, and are highly familiar with their local farming communities and landscapes (Table 13). The Thailand group had researchers who worked actively with the national department of agriculture. Participants from Cambodia and Laos were all researchers involved in extension services with farmers. The Philippines group included a mix of researchers and government officials who have been commissioned to collaborate and work on future ISARD projects, and had the highest number of attendance due to logistical feasibility. These Philippine participants were the first to work with SEARCA in advancing ISARD through pilot projects, with Cambodia, Laos, and Thailand as possible future pilot countries. The higher number of participants from the Philippines was due to the fact that SEARCA has two pilot projects in Leyte and Mindoro islands in the Philippines, which SEARCA aimed to establish shortly after this study. As this was a qualitative study, we did not assign greater value to the themes and ideas to groups with more participants. Rather, the higher presence of Philippine participants meant that we could split the country groups into sub-groups and allowed them to interact with each other. This allowed for greater range and diversity of Philippine ideas for the SEARCA projects they expect to run in the future. The nature of sustainable development challenges makes workshops and conference based analysis useful for exploring complexity and dominant framings of problems (for examples, see Alders and Kock, 2017; Bednarek *et al.*, 2018; Carlsson *et al.*, 2017; Cleland *et al.*, 2012; Picchioni *et al.*, 2017).

All participants were expected to develop proposals in their home countries for future funding from SEARCA with explicit transdisciplinary design. The omission of other major food systems actors, such as farmers, non-government organisations, and business, was explicit in the workshop design. This workshop targeted government agencies and researchers that SEARCA frames as partners in developing and conducting transdisciplinary research. Similar future activities with broader food systems actors remain part of the broader ISARD program.

Table 12: Food and nutrition security context of Cambodia, Laos PDR, Thailand, and The Philippines

Countries	Child malnutrition		Absolute Poverty		Dietary energy supply/balance	
	Prevalence (%)	Number of children below 5	Prevalence (%)	Millions of people	Dietary energy supply (per capital kcals/day)	Dietary energy balance (per capita kcals/day)
Cambodia	28.30	472,383	17.70	3	1974	-246
Philippines	20.20	2,255,249	25.20	24	2356	136
Thailand	9.20	369830.8	12.60	9	2334	114
Lao PDR	26.60	236527	23.30	1	2143	-77
Relevant reference	(Department of Science and Technology, 2013; Ministry of Health, 2012; National Institute of Statistics, 2010; National Statistical Office, 2012)		(World Bank, 2010; World Bank, 2012)		Based on Smith et al. (2000)	

Table 13: Overview of participants present at workshop

Country	Number of participants	Participants' profile
Cambodia	3	University lecturers, agronomy extension experts
Laos	2	University Deans and Vice-Deans of agricultural systems and food science
Thailand	2	Assistant professors, communication extension experts
Philippines	11	Local government unit representations from agricultural departments, President of leading agricultural university, various lecturers, agricultural extension officers

The steps for carrying out the systems workshop were as follows[9]:

1. We introduced the human ecology framework (Figure 14, Table 11) and provided participants with a guide on creating systems diagrams[10]. We gave participants the focus variable *level of food and nutrition security* as this the key normative objective of the ISARD program and an indicator of sustainable development.
2. Each group was asked to prepare before the workshop five slides on the food insecurity context of their food system of interest (Table 12). They were asked to present those slides.

[9] Facilitation note: The table facilitator role was to only assist in probing the group towards thinking in systems by linking their variables to other variables. The feedback processes are to be captured by the groups.

[10] See supplementary material (Appendix 2). This guide can be used by readers to design similar workshops. The central variable is adaptable to any sustainability problem being studied.

3. Participants were grouped by their country of origin.
4. Each group was asked to identify by brainstorming the different environmental, social, institutional, and conceptual variables that they saw as the primary change driver in whichever commodity type was most relevant to them. The specific focus on a commodity allowed participants to provide in depth insights into the challenges and opportunities for working within their immediate food system.
5. Each group was asked to follow the guide and develop a systems diagram to identify the major drivers that influence food and nutrition security in their contexts. The diagrams could be drafted and revised during the group discussions.
6. Once a major systems diagram was developed by each group, they were asked to identify the primary variables that they saw as being affected as the focus variable of *food and nutrition security* changed due to feedbacks.
7. Finally, they examined any emerging behaviours that resulted from an affected variable feeding back to influence change in a driving variable.
8. Participants were then asked to share with the whole workshop why they had chosen the variables that they did, how they had constructed their diagrams including how the variables affected one another, and what key behaviour they thought it revealed.

The outcome of this group activity was one systems diagram per group showing the drivers of food and nutritional security, and the patterns of change resulting from the feedback between driving and affected variables. All diagrams were hand-drawn on large pieces of paper and colourful cards. Towards the end of the day, the final diagrams were prepared in Vensim by the research team and discussed with participants for feedback. Participants were asked to group the variables they wrote down under the state of ecosystems, state of institutions, and state of human wellbeing components of the framework. These four diagrams formed the primary data that was used to analyse the links between the four meta-variables in the human ecology framework for the primary commodity for each country.

After the workshop, the facilitation team used the four final group diagrams to populate the framework in Figure 14. The state of discourses was developed by the research team only based on diagram results from the workshop and paper records of the explanation given by the participants at the time. The research team grouped these and integrated the major themes into the human ecology framework to discuss dominant framings of food and nutrition security. Using the workshop material to populate the framework enables research managers and policy makers to see what generic aspects can be transferred to other cases, and what elements are specific to a local context.

Our method is limited by the purposeful selection of participants from four countries, which binds analysis to policy and research perspectives on food systems. Parallel activities with smallholder farmers are ongoing and beyond the scope of reporting in the aims of this paper. Another limitation was the participant's focus on a specific agricultural commodity, which sets an immediate boundary for the system. To reconcile this, the open discussions throughout the day aimed to draw

links with broader food system elements. The boundary around one element, however, allows participants to have a coherent sense of the scale they seek to influence. All participants spoke professional level English, and completed the exercises in English, although they were given the option of having their group discussions in their own language. The integration of findings into the conceptual framework was a theoretical exercise by the authors for linking empirical observations from the workshop with sustainability science frameworks and food systems debates, and as a heuristic device for conveying the participants reception to ISARD back to SEARCA.

5.5 Results

In this section, we present system of interest per country group, and the final systems diagrams produced by participants. We present the diagrams for each country and our brief interpretation of them based on the food systems and human ecology literature presented earlier in the paper. The country-specific diagrams allowed us to then compile them and integrate them into a single human ecology diagram, presented at the end of this section.

5.5.1 Cambodia

The Cambodian group focused on household livestock production (Figure 15). The group emphasised that to improve food and nutrition security at household levels, more beef had to be produced by smallholders due to growing demand for exports. Figure 15 shows two main drivers this group believed were influencing food and nutrition security. The first was the amount of off-farm feed available for cattle. The diagram shows that this group saw the state of ecosystems as a major issue in both accessing feed and degrading landscapes. The group showed that large stock numbers would improve food and nutrition security, but would come at environmental costs particularly under drought conditions, as this external factor would influence the availability of feed. The second driver that they identified was a need for veterinary knowledge and services to farmers to increase the amount of beef supplied to markets. The group argued that technical knowledge and farm inputs such as capital, feeds, and other risk reduction tools like agri-insurance are needed for a successful beef cattle production, noting that smallholder farmers commonly have limited access to these. The group identified government policy and programs as having the potential to increase animal husbandry knowledge, and thus increase number of cattle per household. These policies would in turn increase the amount of beef supplied and increase incomes. This was perceived as being a positive driver to increase food and nutrition security. The right-hand side of Figure 15 shows the perceived influence of changes in food and nutrition security, including stronger, wealthier, and healthier communities. The group also identified a feedback between increased demand for beef and the amount of beef supplied.

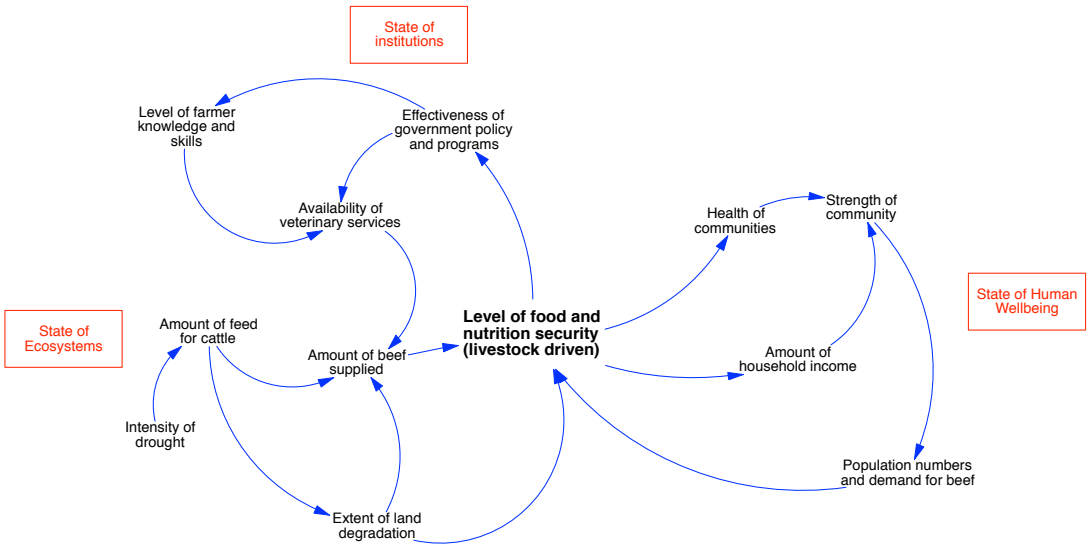


Figure 15: Cambodia – drivers and effects of food and nutrition security

The application of labels for variables used in the human ecology framework (the red boxes in the diagram) highlights the conflict between increasing food and nutrition security through beef production, and subsequent negative impacts on the state of ecosystems. The diagram shows that more cattle are perceived as better, but this at the same time will come at environmental costs, such as land degradation and intense water use. In periods of drought, these would be even higher as feed would be less available. As such, any interventions focused on improving animal husbandry and productivity will come at natural resource costs unless adaptation strategies are built into the interventions. The institutional driver in this system was perceived as the government incentives and training on animal husbandry. Although participants were selected specifically for their connections with farmers, it is noteworthy that farmers were not mentioned as being active agents in this system, with their levels of competency as dominant agents being dependent on improved government incentives and extension services. The fundamental problem was seen to lie in the structure of the system, which, as presented by the group, ensures that any success in improved food security by simply increasing total volumes will inevitably be self-eroding. If these improvements lead to degraded landscapes, it may well prove to be irreversible and have negative long-term social and environmental outcomes, and implications for food and nutrition security.

5.5.2 Laos

The Laotian group focused on household swine production as the major driver of food and nutrition security outcomes (Figure 16). This group's diagram shows multiple policy and institutional variables impacting the number of pigs a household could produce. Participants perceived the macro-economic context as negatively affecting household swine production, largely through expansion of large piggeries in the country. Localised household variables included the size of household, distance to markets, and farm productivity, and these were reported as influencing a

household's ability to compete. The diagrams show that an increased in household surplus can increase both education levels and technical knowledge about how to reduce the cost of household swine production and so improve swine productivity. This feedback loop shows that education and knowledge are perceived as being dependent on household income. Negative consequences from increased productivity included exposure to waste and pollution.

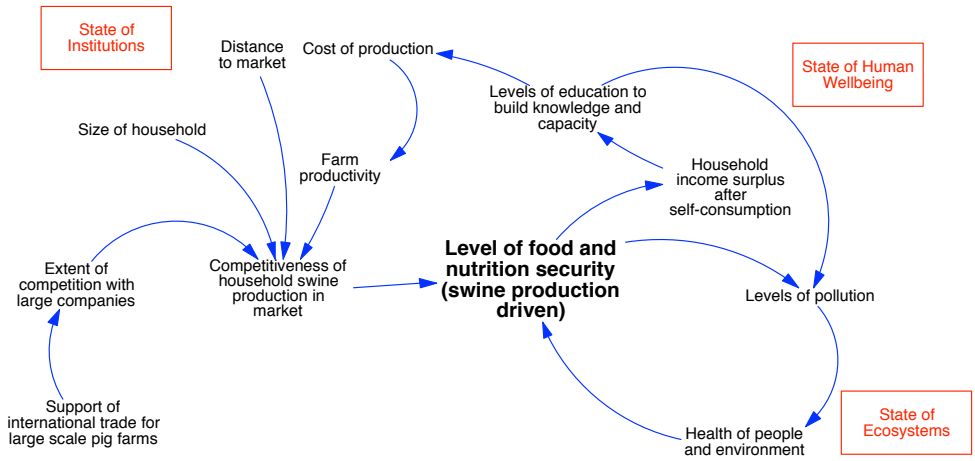


Figure 16: Laos – drivers and effects of food and nutrition security

The Laos diagram has similar conflicting patterns as in the Cambodian diagram relating to increased household productivity and environmental degradation. Unregulated backyard pig farming productivity can lead to poor waste management practices that could negatively affect the community and environment, and ultimately levels of food security. The Laotian group's dominant discourse prioritised pursuing knowledge to increase productivity and de-emphasised mitigating environmental impacts. At an institutional level, the large-scale pig-growers were seen as competing with smallholders, raising the risk of increasing poverty and reducing food and nutrition security. As with the Cambodian example, the structure of the system has an inbuilt relationship whereby the proposed solution will feedback to erode the success of that solution.

5.5.3 Thailand

In contrast to the Cambodian and Laotian participants' focus on local and household scales, the Thai participants focussed on the global market and the strength of organic policies. Their focus was on the ability of Thailand to remain self-sufficient in key commodities, and remain a competitive food exporter. They chose organic vegetable market as their system of interest, reflecting the growing policy and corporate focus on organic production in Thailand. Food and nutrition security for these participants was conceptualised as the national capacity to generate income from organic products (Figure 17). Participants emphasised policy incentives to shift from conventional vegetable farming to high-value organics as a core-driving variable in this system. The Thai participants' diagram combined policy and institutional variables, ecosystem health variables, and human health and wellbeing variables. This diagram showed a more acute concern for broader drivers, such as

consumers' behaviour and policy, than the Laos and Cambodian diagrams, which focused on farm level interventions. For example, the Thai diagram shows consumer awareness of the health impacts of chemicals used in food production as an influencing variable. This concern reinforces government policy supporting organic food production and results in reduced government incentives for chemical inputs into food. This in turn reduces the extent of chemically polluted soils and water systems, which increases community awareness of the role of chemicals in food systems. This also positively reinforces the belief amongst consumers that safe food systems are low-input or organic systems.

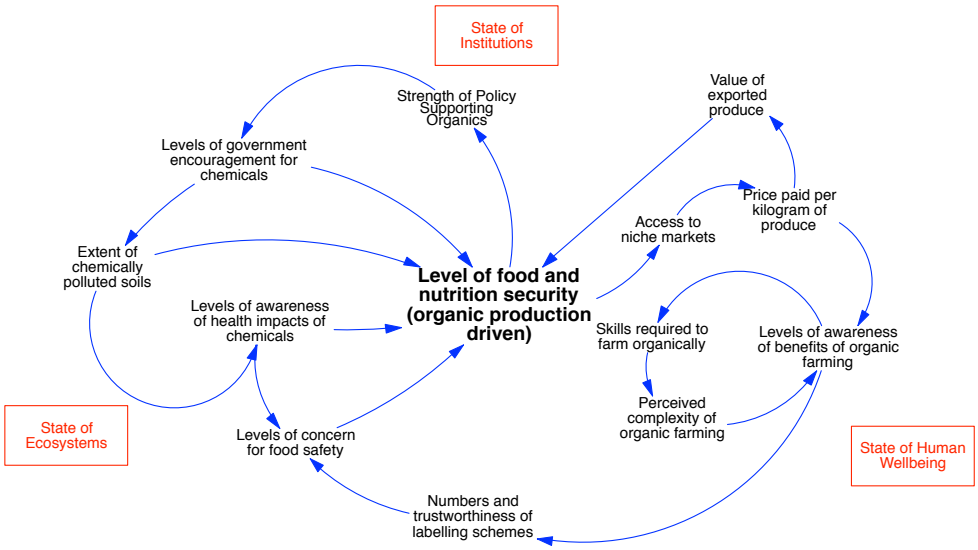


Figure 17: Thailand – drivers and effects of food and nutrition security

Thai participants noted that as consumer awareness and government policies were shifting consumer demand towards more organic products, this change could reduce the extent to which those products were 'niche', and thus, reduce income generated from those products in the future. Two potential conflicting feedback loops drive this change. The first is that as domestic niche markets become oversupplied, the price paid per kilogram of organic product will decrease. For some producers, this increases the attractiveness of exporting to international markets where domestic supply of organics is not being met by domestic production volumes, and so a premium niche market price can still be obtained internationally. The group noted that this could have consequences for domestic consumers, who would see a reduction in locally produced organic products in the long-term. However, diverting organic produce to exports would also tend to keep the price paid for organics above that paid non-organic produce, which, together with lower input costs, tends to increase other farmers' awareness of the benefits of switching to organic farming. The second driver was the suggestions that farmers feel organic farming is too complex and that they lack the skills to do it. However, the awareness of organic farming benefits generates a small reinforcing loop where farmers are stimulated to learn the requisite skills and realize that organic

farming is not as complex as previously perceived. Other farmers, unwilling or unable to make this effort, are tempted to pass off their conventional products as organic products to take advantage of price margin advantages. This stimulates the need to have regulated and enforced labelling schemes that certify organic products are what they claim to be, and to reassure consumers that their food safety and quality concerns are being met.

Although the above processes see a major shift in Thai production and consumption towards organic produce, the Thai participants were concerned that if Thai food producers prioritised the international market for safe, organic products, at the cost of domestic consumers, then Thai production for Thai consumption would become restricted to meeting only the demand of Thailand's own affluent classes with the remainder exported. The size, growth, and consistent prices available in international markets therefore encourages farmers to give up their local sovereignty and participation in local systems, prioritising international systems. Thai farmers, consequently become dependent on servicing affluent consumers in international food systems, while less affluent Thai consumers start relying on cheap, non-organically produced food imported from international food markets, making Thai food and nutrition security more vulnerable to international market shocks.

5.5.4 The Philippines

The Philippines group focused on jackfruit and calamansi (Philippine lime) production as a potential high value product for export to profitable export markets. Participants showed that increasing productivity of both commodities is the main way in which food and nutrition security could improve for farming communities (Figure 18). The group noted that public institutions were the most relevant actors in influencing productivity increases. The group proposed that access to training and new technologies could be core activities supported by government that would help improve productivity, for example, in the form of planting material and harvesting technologies for the specific commodities. The group also indicated that for these technologies and trainings to work, farmers need to be aware and willing to learn. In this view, productivity increases could occur if farmers are aware and willing to expose themselves to new training and technologies.

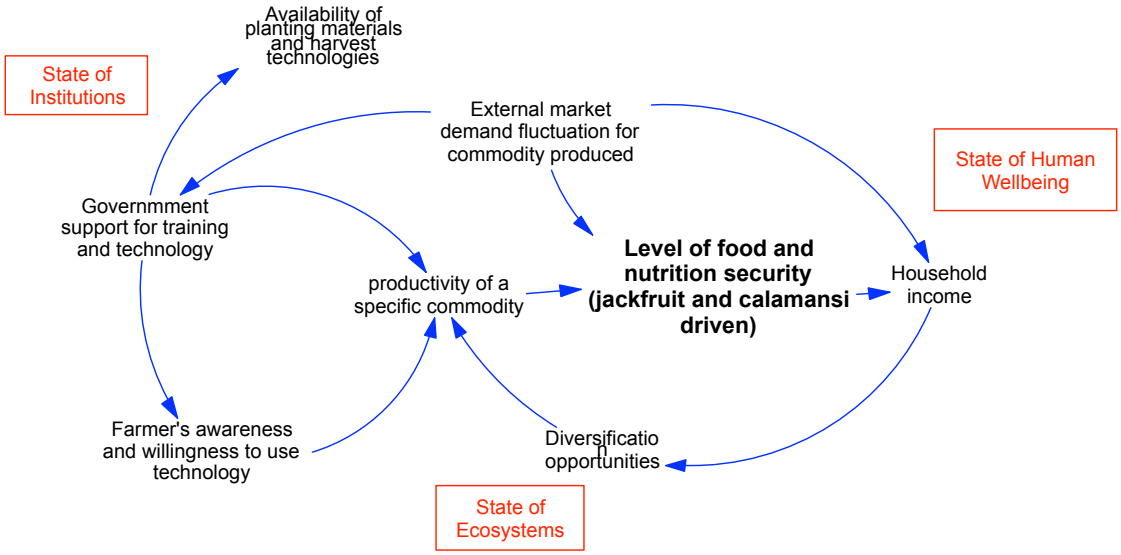


Figure 18: The Philippines – drivers and effects of food and nutrition security

On the affected variables of this diagram, participants indicated changes in household income, diversification opportunities, and external market demand. Household income was presented as the main variable that would change depending on whether more jackfruit or calamansi were produced. Profits from commodities sold to markets would open up the opportunity of diversifying agricultural practices towards newer higher value commodities. The participants linked this diversification to the variable 'productivity of specific commodity', indicating that the more commodities that are efficiently produced, the greater the food and nutrition security outcomes from the system. Participants also indicated that markets beyond the locality would significantly affect food and nutrition security. This would come through fluctuations in demand and price of specific commodities, and the possible increased awareness for safer and organic branded products, similar to the Thai diagram.

5.5.5 Integrative diagram

After all group diagrams were reviewed by each group, the research team proposed an integrative diagram (Figure 19, Table 14). This was produced through capturing common meta-variables prevalent across the four diagrams across the ecosystems, human wellbeing, and institutional variables. The resulting diagram shows the strong emphasis on governments as core institutions enabling technological support, policies, and training. These activities support a dominant discourse geared towards technological solutions to improve productivity of key commodities across different landscapes (Link 1 and Link 2). The discussions on sustainability of landscapes and increased household incomes fit into the dominant ecosystem and human wellbeing variables. Combined, the diagram shows a system where government support for commodities is perceived to lead to increased incomes, and assumed that this will lead to improved food and

nutrition security. The framework enabled the research team to capture the structural similarities between the four countries to capture common understandings of food and nutrition security.

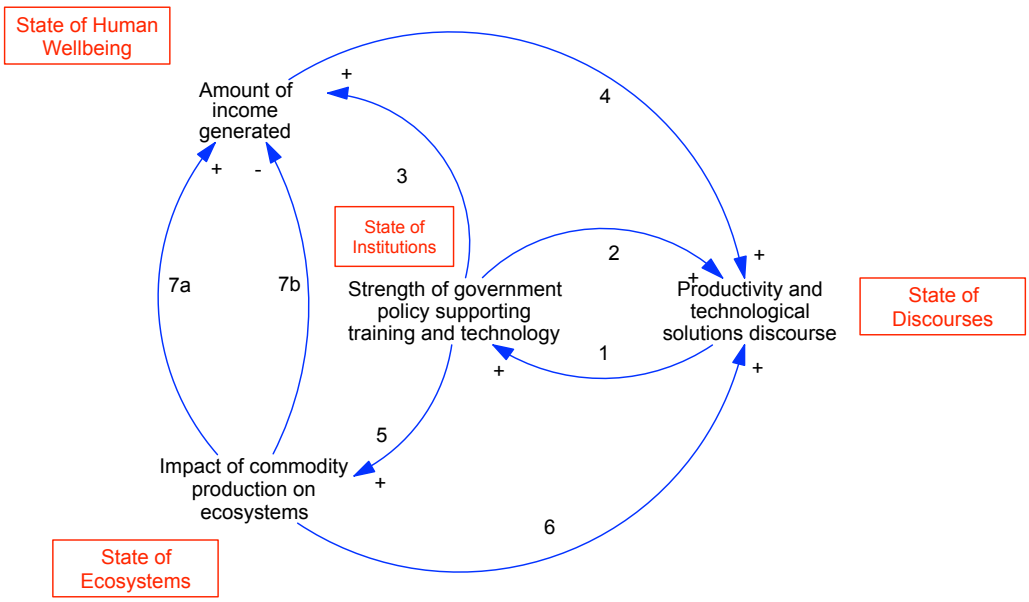


Figure 19: Application of human ecology framework to workshop findings

Table 14: Human ecological shared understanding for improving food and nutrition security

Arrow number	Processed described by the arrows between variables
1	Observations that there is a gap between the levels of technological knowledge that the farmers hold and the levels that they need in order to increase their food security stems from a belief that solutions to problems lie in increased productivity and technology. This discourse leads to a range of government institutional policies and practices aimed at raising the farmers' levels of technological knowledge and the availability of expert technical assistance.
2	Observations by policy makers that farmers are shifting from being a majority that are technologically ignorant to a majority that are technologically aware further reinforces a belief in the value of productivity and technical solutions. Farmers that are not taking up the technology offered are seen as recalcitrant and either subject to further intervention to persuade them to do so, or viewed as 'beyond help'.
3	Actions taken to strengthen government policies that promote technology do not directly result in processes that raise income, as income is raised via increased commodity production. However, the relationship between the policies and income is seen as positive.
4	Income levels are seen as strongly correlated with the general health and wellbeing of the community and so observations that income is rising positively reinforces the technological innovation approach. It is important to note the strong assumption that more *produce* is equivalent to *more income* - except when the produce is of inadequate quality to meet the market's demand. There is no consideration that there might be, for example, structural issues relating higher volumes of product to lower unit price per volume of product, such that increased volumes of production in fact have only limited capacity to increase income.
5	Pro-technological innovation by government agencies results in activities designed to improve a range of agricultural technology and infrastructure. Examples given include pre- and post-harvest infrastructure, transport services, and production and processing technologies. Collectively, these processes serve to increase levels of commodity production and reduce loss. These interventions amplify ecosystem change through commodity production unless the technologies are geared towards reducing environmental pressure.
6	Observations that commodity production increases with technological innovation further reinforces the belief that farmers' attitudes will shift to be increasingly favourable towards technology. It is also believed that with appropriate technology, commodity production increases without undue impacts on ecosystem health, whereas without technology, increasing production is likely to be unsustainable. The overall belief is that technology is either neutral or beneficial to the environment.
7a	Most groups saw increasing commodity production as resulting in processes that directly increased farmers' income, particularly if the quality of the product as delivered to market was also enhanced. Examples where this did not hold, such as gluts in banana production, were seen as rectifiable by switching to another commodity where it would hold, such as jackfruit.
7b	An exception to the positive influence of increased production on income was noted in the case of highly seasonal products where supply would exceed demand and depress prices. This group noted that the relationship would only be positive if some farmers diversified into other crop types and market gluts were avoided.

5.6 Discussion

Our results showed how researchers and policy makers perceive the social, institutional, and ecological dimensions of different commodity systems in relation to food and nutrition security in Cambodia, Laos, Thailand, and the Philippines. The workshop activities were successful in fostering

dialogue between diverse participants from various backgrounds and helping to build mutual comprehension of food and nutrition security across different contexts. In this way, the approach taken in the workshop both helped build a collaborative partnership as well as demonstrating to the participants the value of building such partnerships in any future collaborative projects that they undertake. The major finding after the integration of each groups' perspectives into the human ecology framework is that of a discourse common to all groups. This discourse focuses on increasing productivity through government training and belief in technological solutions (Figure 19, Table 14). The relationship between technological solution and governments as dissemination agents is shown by Links 1 and 2. Links 3, 5, 7a and 7b show the feedbacks from government interventions on incomes and agroecosystems. The workshop has provided a template for the understanding of a core group of people tasked with conducting future transdisciplinary food systems research. The captured understanding aligns with dominant literature and experiences of agricultural interventions, yet they offer ways of leveraging future activities towards nutritional outcomes, production diversification, and increased farmer inclusion. Next, we discuss these themes in light of regional and global food systems literature.

5.6.1 Leveraging from dominant understandings

The results placed government as the core agent tasked with influencing food and nutrition security (Figure 19, Table 14). All group diagrams (Figures 15-18) centred on improving smallholder wellbeing, largely through improving incomes. The findings suggest that that smallholder farmers are passive recipients of policy and political interventions; something which is commonly noted in agricultural programs (Zamora *et al.*, 2013). This passive absorption of training drives the system's behaviour which seeks to increase commodities, and therefore incomes (Links 3 and 5). Other studies have analysed the dominant top-down governance structures that have left out farmer concerns from food systems policies (Borras, 2007; Clapp, 2017), leading to unjust and inequitable outcomes. The sustained exclusion of farmers understandings in interventions risks missing the multi-generational accumulation of local knowledge of changing climates, soil quality, and biological dynamics of agricultural systems (Altieri and Toledo, 2011; Carpenter, 2003; Wright, 2014). Given the dependency Southeast Asian urban consumers on smallholder farmers' production (Lowder *et al.*, 2016; Wahlqvist *et al.*, 2012), future agricultural interventions should emphasise the inclusion of farmers interests and strategies to work towards balancing household food and nutrition security outcomes with meeting market demands. Our results can help research and policy agencies in Southeast Asia use the shared understanding to develop ways for farmers to contribute to framing agricultural interventions. Developing a novel understanding of farmers as stewards of change in their landscapes can offer a 'deep' leverage point in a system where dominant understandings are re-defined (Abson *et al.*, 2017). The failure of current food systems to meet just and equitable outcomes is well documented (Davila and Dyball, 2018; IPES Food, 2015), and thus the current perceived solutions through training and extension can be leveraged to guide interventions that

explicitly address these inequalities. Research agencies can be catalysts in promoting knowledge extension models that include the unique knowledge farmers hold on ecosystems and production systems.

The dominant understanding of market food security discourse, focusing on yields and incomes, risks ignoring broader issues of nutritional outcomes and environmental wellbeing. The workshop confirmed that there remains a core focus on increasing yields and meeting nutritional outcomes through incomes, confirming past studies in the region and globally (Ingram, 2017; Lang and Heasman, 2004; Lee, 2012; Timmer, 2015; Wahlqvist *et al.*, 2012; Zamora *et al.*, 2013). This traditional focus on yield productivity has come with environmental costs and inequitable distribution of financial benefits (Altieri and Toledo, 2011; Carolan, 2016; Lee, 2012). The dominance of agro-economic framing of solutions, focused on trade policies geared towards increasing volumes of food products, has dominated development policy and food programs since agricultural technologies and input expanded in the 1970s, yet food and nutrition security remains a major human development goal (Fan and Brzeska, 2016; Ingram, 2011a; IPES Food, 2015; Lee, 2012). Support towards specific commodities is able to improve household income as long as markets can continue to absorb the increased output without eroding the unit price paid, otherwise the farmer will see declining incomes despite greater volumetric output (Sawin *et al.*, 2003). Focusing on incomes also assumes households will use incomes to access nutritious food, which may not be available, or inflation and other household costs may prevent families from purchasing nutritious produce (Fanzo, 2014). For example, the rapid economic growth in Thailand has shown that increased incomes in rural and urban landscapes are not leading to adequate nutrition, with obesity affecting approximately one third of the Thai population (Kelly *et al.*, 2010). The Philippines is experiencing similar nutritional transitions, with undernourishment affecting rural areas and obesity affecting urban areas, and whilst Laos and Cambodia continue to face high poverty and dietary transition as developmental projects are implemented (Davila, 2018; Pittock *et al.*, 2017b)

The current understanding on yield and incomes offers one perceived pathway to food and nutrition security, however future research and policy strategies can explore how alternative discourses may lead to different food outcomes that focus on environmental and nutritional variables. One alternative pathway can be leveraged from developing training packages that focus on diversification of commodities in individual farms, as this has the potential to be more productive per hectare than mono-cultured farms due to this diversity of produce (Altieri and Toledo, 2011; Nicholls *et al.*, 2016). This would see a change in Link 5 in Figure 19, where incentives are geared towards diversification. Production diversity also has the possibility of improving both nutrient cycling and the nutrient content of the food produced (Powell *et al.*, 2015; Sibhatu *et al.*, 2015), and the chance of meeting global food and nutrition security goals. Experiences from the Philippines show that shifting production focus beyond yields towards nutrition sensitive interventions designed between local communities and agricultural offices can improve local nutritional outcomes (Zamora *et al.*, 2013). The findings in Figure 19 indicate that government training could be used as levers to

change the focus from yields towards diversification and nutrition sensitive approaches can expand the types of agricultural interventions to meet developmental targets. One emerging way of connecting research with policy and farmers is a transdisciplinary approach which can guide the development and implementation of alternate interventions that address social and environmental development challenges.

5.6.2 Systems frameworks for transdisciplinary research

This study shows that systems frameworks can enable different groups to constructively reveal the inequalities and tensions in how problems are being framed and interventions designed (Newell and Siri, 2016). Systems frameworks can be operationalised through quantitative or qualitative methods to reveal different insights in particular systems. For example, Waterlander *et al.* (2018) document the value of systems framework in bridging public health concerns and power imbalances to form part of food interventions. Carlsson *et al.* (2017) demonstrate how workshops and surveys can guide the identification of food system indicators across scales, Orr *et al.* (2012) and Porter *et al.* (2014) use global quantitative databases to demonstrate the systemic implications of hydro-power and food trade networks, and Ison *et al.* (1997) reveal the value of systems thinking for learning in adaptive natural resource management. The ability of systems frameworks, such as human ecology, to capture the underlying feedbacks in a specific food system makes them valuable for advancing the growing field of transdisciplinary food systems research (Francis *et al.*, 2008). Human ecology as a systems framework also enables the cross-comparison of individual case studies, which can advance the identification of common structures and feedbacks that can be relevant to other policy and research areas (Adler *et al.*, 2018; Magliocca *et al.*, 2018; Newell and Siri, 2016).

In a changing world where knowledge is debated, values and interests contested, and the need for urgent decisions, there is a need to facilitate inclusive processes to build shared understandings of problems (Colloff *et al.*, 2017; Newell and Siri, 2016). Core to transdisciplinary research is the explicit focus of enabling co-productive capacities amongst stakeholders to increase the flow of knowledge between science and policy domains (van Kerkhoff and Lebel, 2015). This requires ongoing careful consideration of the power imbalances embedded in transdisciplinary research, and the costly nature of intensive collaboration over prolonged periods of time (Miller and Wyborn, 2018). Our results confirmed the values assigned to smallholders through the perception of farmers as passive recipients rather than co-creators of knowledge. This poses the need to address equity concerns during the front end of transdisciplinary research design, where stakeholders are identified and involved in problem framing (Lang *et al.*, 2012). Methods that include relevant stakeholders are increasingly used in research for natural resource management policy, as they allow for more salient findings and more rapid uptake of generated knowledge (Barreteau *et al.*, 2010; Benham and Daniell, 2016). For Southeast Asia, expanding the use of highly participatory techniques that capture farmers' interests and involve them in designing research activities will be critical to meaningfully conduct transdisciplinary research. The research has provided a method for revealing the conceptual

underlying inequalities in a system and can be used in future participatory research and policy design.

Future research will need to capture the extent to which farmers are willing and interested in participating in transdisciplinary processes that often emerge from research and government institutions. Our study is limited to the shared understanding of selected researchers and policy makers from Cambodia, Laos, Thailand, and the Philippines invited to participate at SEARCA's initial ISARD activities. To address this limitation there needs to be ongoing application of similar systems-based exercises with smallholder farmers and other policy agencies from different countries to improve the evidence base for the value of qualitative systems-based approaches in transdisciplinary food systems research.

5.7 Conclusion

In this paper, we documented how researchers and policy makers from four Southeast Asian nations perceive food and nutrition security challenges and solutions for their home regions, and the implications of these perspectives for future food systems transdisciplinary investments. We leveraged from a regional research agency's vision to expand from traditional disciplinary agricultural research in Southeast Asia, and conducted a workshop with research and policy experts tasked with developing transdisciplinary food systems research. We used a systems-based human ecology framework to gain insights into participants' dominant understandings of pertinent issues and key agents involved in the system. The method was a workshop diagramming process to capture schematic representations of the key challenges to food and nutrition security as identified by participants. The application of the framework revealed how the dominant perspective on expanding staple commodities and lack of integration of farmer voices poses challenges for transdisciplinary research, and specifically presents a significant obstacle to the conduct of participatory rural development programs.

The dominant belief that technical solutions to increase production are the best way to improve food and nutrition security is a risk to transdisciplinary food systems research. The risk lies in not fully incorporating farmers' concerns, cultures, and knowledge systems into research and policy design. To overcome this, we recommend that the perception of government as agents of changed is leveraged to design new training and interventions. Localised government policies and programs could be used to explore novel food activities in the food system and gauge how human and environmental systems react to such changes. Concerns over balancing commodity production and reducing environmental degradation can also be used to explore integrated production systems that deliver a diversity of produce. This is critical for future food system sustainability, as such methods help identify optimal intervention points likely to improve the state of a system and avoid 'solutions' with unintended outcomes on other parts of the food system.

The use of a systems-based human ecological framework has provided insights into how food and nutrition security are perceived amongst Southeast Asian policy makers and researchers. The

framework was shown to help researchers navigate the often-conflicting perspectives and values associated with a sustainability problem. Policy makers can learn from this paper to critically reflect on the extent to which smallholder farmers' voices are used to design novel agricultural interventions. For transdisciplinary food systems researchers, we have provided a systems-based framework and method that can capture different understandings of a specific sustainability challenge. The use of human ecology and systems-based frameworks can guide collaborative interventions into food systems that include communities tasked with improving food and nutrition security.

Chapter 6: Human ecology and food discourses in a smallholder agricultural system in Leyte, The Philippines

Full reference: **Davila, F.** (revision submitted). Human ecology and food discourses in a smallholder agricultural system in Leyte, the Philippines. *Agriculture and Human Values.*

Status: Resubmitted to journal March 2019.

In Chapter 5, I showed how the human ecology framework can be used to analyse understandings of food and nutrition security research and policy a workshop method. Diving further into the challenges of rural development in the Philippines, I now turn to the insights and experiences of food and nutrition security among smallholder farmers in Leyte, the Philippines.

As per Table 1 in Section 1.6, in Chapter 6 I contribute towards answering the thesis question: *What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?* I do this through analysing 39 semi-structured interviews with smallholders, following the human ecology framework as my analytical guide. For the specific manuscript submitted to Agriculture and Human Values, I answer the question: *what are smallholders' understandings of their food security, and what are their perceived interventions to improve food security?*

My findings show that farmers perceive market food security discourse as the main way out of food insecure situations, and thus continue to seek institutional support for maintaining a coconut

based agricultural system. Farmers also perceive elements of the food sovereignty discourse, notably decision-making agency and agricultural diversification, as parallel strategies to improve their food security. The ongoing support for coconut production and inequitable access to training and knowledge in rural systems traps farmers into a market food security driven system. The paper demonstrates that farmers are aware of the interventions required to diversify food systems towards higher value commodities, yet sovereignty is unlikely to be enabled due to maladaptive institutional and social networks. The use of human ecology advances food scholarship through embedding a systems analysis into qualitative studies to reveal the influence of food discourses on food systems' behaviour and outcomes.

Food systems are made up of interactions between biophysical and human drivers that influence food activities, with the ultimate objective of achieving food and nutrition security (Ingram, 2011a). The Food and Agriculture Organization (FAO) defines food and nutrition security as a situation where all people at all times have access to sufficient, safe, and nutritious food to meet their dietary needs and preferences for an active and healthy lifestyle (FAO, 2018). Despite an abundant presence of food in world markets, 821 million people remain in chronic hunger and a further one billion undernourished (FAO, 2018). Smallholder farming households in the developing world work towards meeting daily food and nutrition security through balancing subsistence agriculture with cash commodity production (Ickowitz *et al.*, 2019). Smallholder agricultural activities support rural incomes and are responsible for producing 35% of world's food, making agriculture a major driver in human development (Ricciardi *et al.*, 2018). Despite their significant contribution to global food output, smallholders fail to have adequate nutrition and are faced with ongoing pressures to intensify or alter their agricultural practices to meet global development and market needs (Dressler *et al.*, 2016b; Fanzo, 2017). To overcome hunger and malnutrition with locally salient strategies, there needs to be a nuanced understanding of the socio-political realities that influence agricultural practices and policies that influence food system activities (Hospes and Brons, 2016; Lövbrand *et al.*, 2015; Wald and Hill, 2016).

Food discourses, as underlying ideas that influence how individuals and groups take action across the food system, are important drivers of human behaviour (Constance, 2019; Marin *et al.*, 2016). Analysing the underlying discourses and structures that cause particular problems requires sustainability oriented frameworks that capture human and environmental interactions (Abson *et al.*, 2017; Davila *et al.*, 2018). Drawing these links can be done through using human ecology as a guiding analytical framework. Building on Dyball and Newell (2015), here human ecology is defined as a framework suitable for understanding the relationship between discourses and changes in human wellbeing, ecosystems, and institutional behaviours in a specific context. The framework allows for a coherent analysis of the feedbacks between different discourses and variables in the system. Human ecology openly critiques reductionist methodologies that distil complex problems into technocratic entities, limiting the researcher's ability to contextualise such observations in the broader cultural and historical processes that have influenced particular systems (Dyball, 2010; Dyball, 2017; Rambo, 1983). Human ecology provides a methodological structure for looking at complex sustainability problems in detail while acknowledging the broader social and environmental processes that influence the system (Dyball, 2010; Dyball and Newell, 2015; Marten, 1986; Polk and Bruckmeier, 2005; Rambo, 1983). The explicit concern for going beyond describing the state of systems and identifying how different human held discourses influence the systems behaviour makes human ecology a suitable tool for analysing the paradigmatic root causes of sustainability challenges (Abson *et al.*, 2017).

This paper documents how smallholder farmers embody market food security and food sovereignty discourses in their own agricultural system, and how these discourses lock the system

and prevents alternative agricultural practices from developing. The research question for this study was: *what are smallholders' understandings of their food security, and what are their perceived interventions to improve food security?* The paper's novel contribution is evidencing how a human ecology framework enables competing food discourses to be identified in a specific case study. The case study of smallholder coconut producers in Leyte, the Philippines is used, and a human ecology framework applied to semi-structured interview data with 39 smallholder farmers. The systems framework captures links between dominant food security discourses and their subsequent influence of human wellbeing, ecosystems, and institutions. The paper presents a visual framework for documenting how specific food actors' discourses influence broader aspects of their food systems in a particular point in time. I document how smallholders frame their food and nutrition security as achieved when they form part of industrial food markets, which provide incomes from the sale of raw coconuts. This pursuit of food security through market dependence withholds smallholders ability to act on the diversification discourse they also. The inability of smallholders to be sovereign agents in agricultural landscapes and work with public institutions to diversify their agricultural practices erodes principles of food sovereignty, instead locking farmers into a purely market food security discourse. This discourse rigidity perpetuates the notion that farmers are passive recipients of agronomic extension targeted at coconuts, rather than active participants in their own food system, reducing their capacity to be sovereign agents in facilitating their food security outcomes. The findings provide an example of how one discourse dominates in agricultural landscapes, withholding farmer sovereignty and diversity of production from developing. The analysis and framework application advances the value of human ecology as a tool for identifying structural systems behaviour, offering a template for capturing how food discourses are present in a specific agricultural landscape.

6.1 Literature review and conceptual framework

Discourses are sets of ideas held by social actors that stimulate action (Dryzek, 1997). Discourses often create 'storylines' of what the root problems of issues are, and are amplified by different groups acting out and promoting that storyline. Food discourses help identify how hunger and malnutrition challenges are framed by different food actors across different scales (Davila and Dyball, 2018; Lee, 2013). Food scholars have debated two major discourses as influencing food practices: market food security and food sovereignty (Davila, 2018; Jarosz, 2014). The *market food security* discourse often looks towards using markets and economic solutions to address issues of hunger, reducing the emphasis on issues of social justice and environmental wellbeing (Jarosz, 2014; Lee, 2013). Critical literature on the market-oriented nature of food security frame it as a discourse that has maintained a focus on maximising total agricultural production, at the cost of human wellbeing and sustainable resource management (Béné *et al.*, 2019; Lee, 2013). For example, it has tended to prioritise the focus of agricultural yields over diversity and quality of produce, leading to long term land use changes and negative environmental impacts (Campbell *et al.*, 2017; Farsund *et*

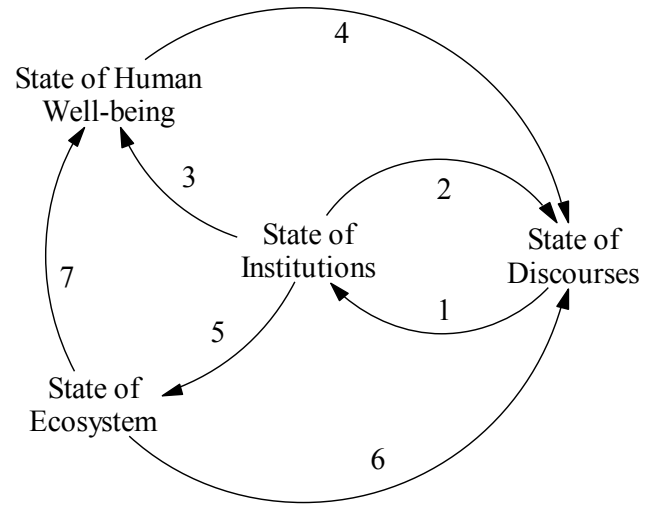
al., 2015; Ingram, 2011a). The pressure of land use in developing countries has been particularly pronounced, with demand for cash commodities such as palm oil and sugar leading to major habitat degradation and loss of biodiversity (Chaudhary and Kastner, 2016). The overwhelming research and evidence of the environmental impacts of agriculture means that social issues such as equity and justice, are diluted within environmental sustainability narratives (Béné *et al.*, 2019).

Contrastingly, the *food sovereignty* discourse emerged from strong farmer activist groups, and supported with critical literature from agrarian change and political economy scholarship distilled the power relations and social inequalities of highly globalised industrial food systems (Desmarais, 2007; Wittman *et al.*, 2010). Food sovereignty is commonly defined as the right of nations and peoples to control their own food systems, including markets, production models, food cultures and environments (Wittman *et al.*, 2010). Food sovereignty focuses on the *processes* that enable food and nutrition security from being realised, contrasting to market food security discourses which focuses on the *outcome,* regardless of the pathways taken to get there (Dekeyser *et al.*, 2018). Ultimately, food sovereignty exposes the structural inequalities, gender injustices, and power dynamics that permeate throughout globalised food systems, and acts as a call for collective action to change food system structures (Dekeyser *et al.*, 2018; Jarosz, 2014).

The ecological roots of food sovereignty lie in agroecological science, which proposes mimicking nature's ecosystems to produce diversified and locally appropriate species, which Altieri and colleagues argue can lead to increased total farm productivity (Altieri, 1995; Altieri and Toledo, 2011; Nicholls *et al.*, 2016). These ecological concerns draw from other frameworks concerned with the socio-politics of food, notably political ecological analysis of how agricultural landscapes change influences social relations and power dynamics (Clapp, 2015; Galt, 2013). The socio-political dimensions of the discourse have also been extensively explored. For example, Soper (2019) critically examines the limitations of the discourse, noting that the discourses disregards for globalised food system can have the perverse outcome of reducing farmers' ability to meet their nutritional and developmental needs. Studies from political economy have focused on how food regimes, analysing how national states and corporations have created a highly industrialised food systems (McMichael, 2014; McMichael, 2016). Bernstein (2014) poses that the peasantry and highly industrialised agriculture are not necessarily opposed, and that the assumed ecological superiority of smallholder farming fails to recognise the ongoing class dynamics that have shifted agricultural landscapes through history. The disregard for international trade markets and emphasise on localisation by the food sovereignty discourse poses risks to the millions of smallholders who depend on established value chains and global consumers (Burnett, 2013; Burnett and Murphy, 2014). While both discourses were originally framed as opposing to each other, development debates are shifting towards questions of how institutions respond to the dual issues of food security outcomes while improving social inclusion and participation of smallholders in food systems (Béné *et al.*, 2019; Davila *et al.*, 2018)

To analyse the dichotomy between both discourses in a specific smallholder context, I drew from the food discourses literature and integrated it within a systems based human ecology framework. Systems based frameworks help identify feedbacks between environmental and social variables, and help diagnose the possible diverse discourses that influence institutional and social structures (Meadows, 2008; Newell and Siri, 2016). Table 15 presents the human ecology systems framework used throughout this study. The four major variables interact with each other through processes that feedback to constrain each other's behaviour, represented in the framework by arrows. Each arrow can have amplifying (+ sign) or balancing (- sign) impacts on other variables. The variables can be populated with quantitative or qualitative observations at various scales of analysis. Links one, three, and five represent individual and collective activity that function to change the quantity or extent of the variables to which they point. Links two, four, and six are observation processes whereby the individual or community receives signals from the 'real world' to either reinforce or change the dominant discourse of how they perceive the system. The discourse that people hold in their heads influences how they interpret the observations of ecosystems, institutions, and human wellbeing. Link seven is not mediated by human interpretation of their environments, rather it is concerned with how changing ecosystems influence human wellbeing. The abstraction of complex problems to four meta variables makes the human ecology systems framework useful for analysis into how detailed case studies link with broader theoretical and policy debates, and to compare and contrast case studies that may have underlying structural similarities (Dyball and Newell, 2015; Newell and Siri, 2016). Using empirical data, researchers can populate variables to create visual schemas the system at a particular point in time as perceived by stakeholders. This can be used to enable discussions of the wider implications of why and how discourses influence the food systems being studied.

Table 15: The human ecology framework



Arrow number	Process represented by the arrow
1	The influence that a dominant discourse has on generating formal and informal decisions amongst individuals or institutions. This includes planning and goal setting resulting in the design and implementation of policies to promote the dominant discourses in society.
2	As formal and informal institutions lead people to behave in particular ways, they will either reinforce or change the dominant discourse. Dominant discourses may change or resist change, as other institutions might reinforce it. If they were changed, they would influence the formation of new institutions to reflect the new discourse.
3	This link shows the implications of institutional decisions on an individual or a community's physical and psychological wellbeing.
4	As communities and individuals change based on institutional activities, dominant discourses may shift, eventually creating new institutional interventions. As with L2, these observations may challenge or reinforce core values, depending on circumstances.
5	This includes collective activities promoted or enabled by dominant social institutions that directly affect the environment.
6	As ecosystems change based on formal and informal institutional activities, new discourses may emerge or dominant discourses perpetuated.
7	Ecosystems are affected by policies and human behaviour, and as ecosystems change they directly affect human health and wellbeing.

6.2 Food systems in Leyte, the Philippines

The Philippines provides a Southeast Asian country context with a large rural population involved in agriculture who remain food insecure and with poor developmental status (UNDP, 2013). A country with more than 7,000 islands, over half of the 100 million people depend directly or indirectly on income generated through the production of key agricultural commodities (UNDP, 2013). Total agricultural land is 12.5 million hectares, just under half the total available land. Agriculture contributes between 12-20% of total gross domestic product (Cororaton and Corong, 2009). Climate change is manifested through intense weather events and unpredictable seasonal forecasts (de Leon and Pittock, 2016). These changes influence smallholders' ability to produce food and meet their daily dietary needs. Agricultural policies support the production of cash commodities for domestic and global markets, and farmers are largely dependent on this income for their household's food security (Davidson, 2016; Davila, 2018; Zamora *et al.*, 2013).

Issues of land rights, food security, and democratic participation in food policies are core to the Philippines' developmental history (Borras, 2006; Borras, 2007). As a previous colony of Spain and the United States of America, the Philippines agricultural and land use institutions have been modelled around a feudal system where large areas of land are owned by affluent individuals that lease, often without any legal agreements, to smallholders (Davidson, 2016; Davila, 2018). The country received significant Green Revolution technologies support, which led to the inevitable debt cycles in low income smallholder farmers and the land expansion into crops for global markets (Bankoff, 2007; Davila, 2018). The Philippines government contends that participation in policy and access to food should be essential rights among smallholder farmers (Government of the Philippines, 1992; Government of the Philippines, 2014), yet pervasive inequality and poverty remain core challenges achieving these government visions. The recent government administration of Rodrigo Duterte has focused on regional populism and rural development (Curato, 2017), yet the smallholders continue to be marginal beneficiaries of development processes. The dominant policy directions which support major export commodities (**Figure 20**), and framings of food security as a national self-sufficiency issue, create a dominant market oriented discourse that prioritises productivity over human and environmental wellbeing (Davidson, 2016; Davila, 2018).

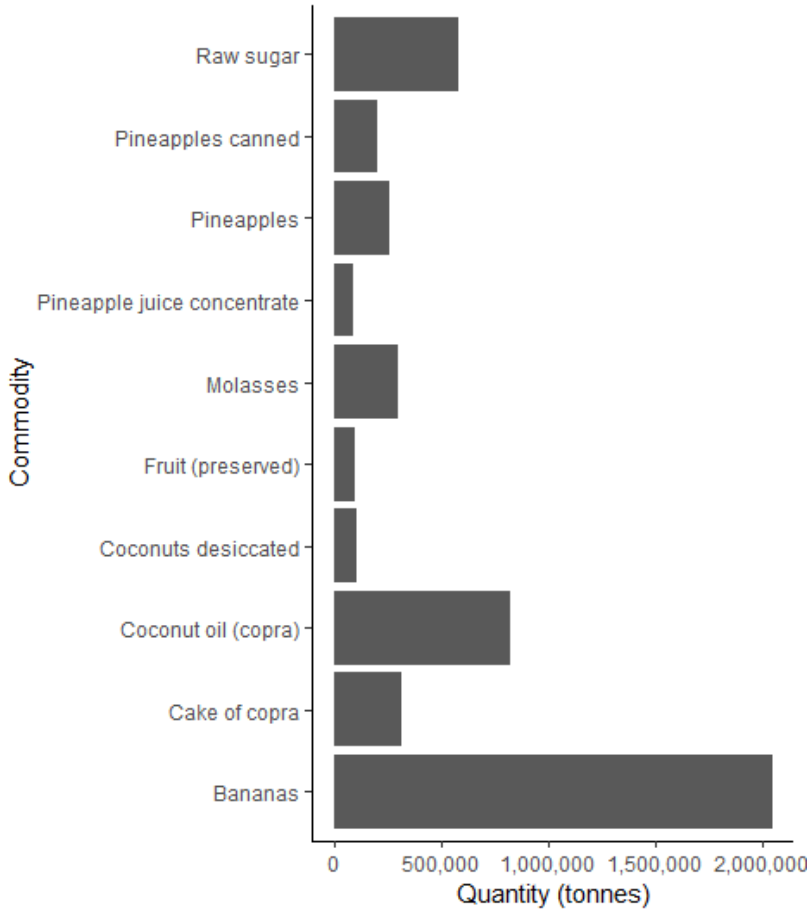


Figure 20: Top ten export commodities in the Philippines (FAO, 2011)

The island of Leyte in the Eastern Visayas region is the eighth largest Philippine island (Figure 21). It is home to 1.7 million people, and 61.4% of the population depends on agriculture for incomes (PSA, 2016, see Table 16). Average yearly family income is USD1,300 and poverty incidence is 30.70% (PSA, 2016). From a total land area of 800,000 hectares, approximately 10% remains as forest cover, with much old-growth and primary forest replaced by coconut and abaca plantations, grown on relatively flat agricultural land (Mukul *et al.*, 2016)[11]. Climatically, the island has a relatively even rainfall distribution throughout the year with annual rainfall totalling approximately 4,000 mm, with a dry season from March to May and wet season October to January, and relatively good soil moisture conditions (Mukul *et al.*, 2016; Navarrete *et al.*, 2013). The island has a long history of settlement and intense land use for forestry and agricultural products dating back to the Spanish colonial era (Bankoff, 2007). In Leyte, elite land-owning families established governance structures and laws that enabled them to have tenants in Haciendas (large areas of private land) working in intensive commodity production, notably coconut and copra (Dressler *et al.*, 2016a). Increasing agricultural productivity in key

[11] Excludes Samar Island

commodities remains a major development plan for the provincial government (Leyte), as well as municipal (town) and barangays[12] (Inopacan Local Government Unit, 2012).

Like in other regions of the world, households in Leyte are highly food insecure, often facing 'hungry seasons' (Bacon *et al.*, 2017; Isakson, 2009; Reyes *et al.*, 2012). Factors that influence hungry seasons vary between commodities, and include a range of market prices and seasonal variability factors which prevent farmers from meeting basic food needs (Bacon *et al.*, 2017). Hungry seasons can be extended when crops fail, severe climatic fluctuations occur, or purchasing power declines among smallholder households. While government responses to hungry seasons often seek to support immediate needs, structural causes of hunger and long term sustainability goals are not included (Bacon *et al.*, 2014). In the Philippines, unpredictable climate change and highly production oriented food policies create ongoing hazards for smallholders, creating high risk for hungry seasons (Davidson, 2016; Davila, 2018).

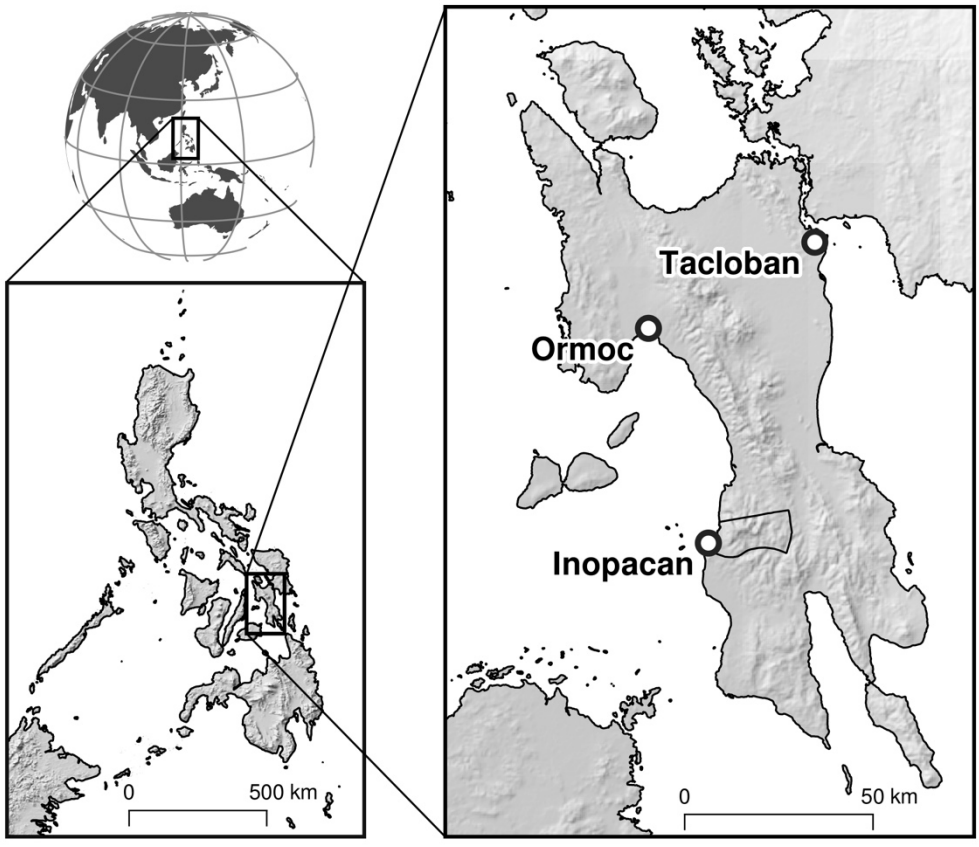


Figure 21: Geographical locations of the Philippines, Leyte, and Inopacan

[12] The smallest administrative political unit in the Philippines

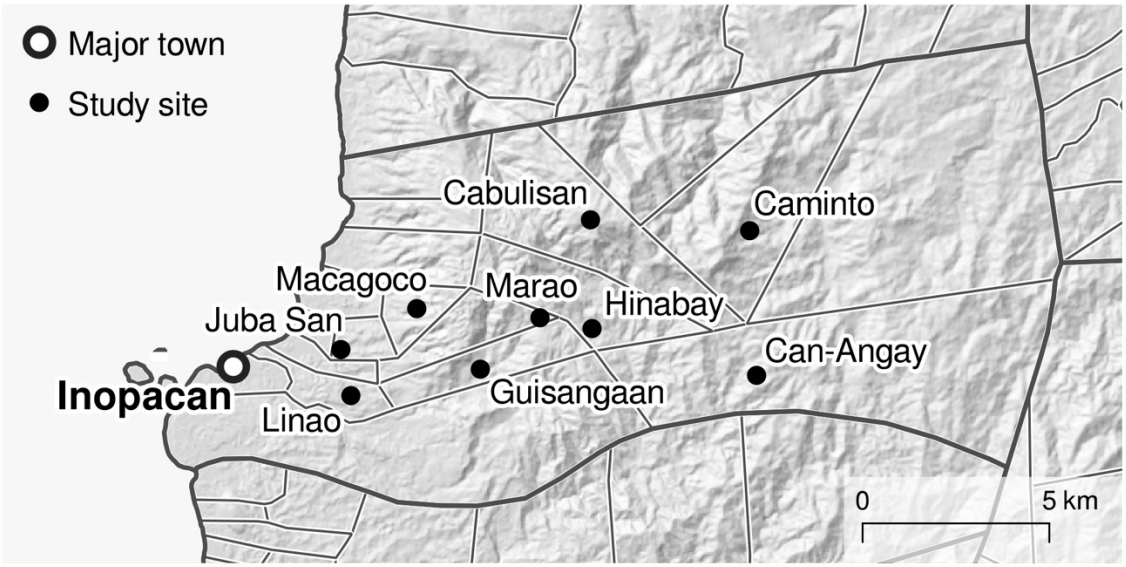


Figure 22: Inopacan barangay distribution and sites visited

Table 16: Top agricultural crops and livestock produced in Leyte (PSA, 2017)

Top five agricultural crops	2014	2015	2016
Palay			
Area (harvested/hectares)	128,993	119,183	116,488
Production (metric tons)	502,146	489,405	473,580
Corn			
Area (harvested/hectares)	41,288	42,520	39,076
Production (metric tons)	58,601	62,238	53,955
Coconut			
Area (planted/hectares)	94,744	94,700	94,744
Production (metric tons)	194,050	201,123	206,702
Mango			
Area (planted/hectares)	164	164	164
Production (metric tons)	128	141	152
Banana			
Area (planted/hectares)	4,895	4,890	4,934
Production (metric tons)	20,859	23,603	26,944
Top five livestock			
Carabao	114,513	117,419	119,099
Cattle	10,817	9,617	10,096
Chicken	465,929	527,756	890,443
Duck	259,230	243,891	210,371
Goat	19,913	17,197	16,003

Inopacan is a town of 20,000 people which lies in South-Western Leyte, has a geopolitical area of 9,699 hectares, and a hilly environment with the highest elevation point at 1000 meters (Figure 22). Inopacan is a 4th class municipality, the poorest type of municipality in the

Philippines[13]. Average individual income is of USD585 per year (approximately USD1.6 per day). There are 4,415 households with an average of 4.3 people per household. Rainfall is evenly distributed throughout the year and the annual average rainfall is approximately 1,638 mm. The landform is predominantly rolling to steep volcanic hills. Soil erosion is a major problem in Inopacan, with approximately 30% of the town's land heavily eroded (Inopacan Local Government Unit, 2012). This is consistent with the broader island of Leyte, which has been severely degraded through decades of intensive land modification (Olabisi, 2011).

The town has 20 barangays, eight of which are coastal, 11 are upland, and 1 is an island. The literacy rate is 89%, and school, health services, and markets are physically accessible for all except the far eastern barangays, where poor road conditions makes transport difficult during heavy rains. Employment is high, with 70% of the population engaged in the labour force. Agriculture is the main economic sector, with coconut being the major cash crop, and other crops such as banana, sweet potato, and cassava intercropped when appropriate. Inopacan has a total agricultural area of 4,107 hectares, of which 3,789 is devoted to planted crops, largely coconuts. Inopacan contributes to Leyte's total coconut output of approximately 200,000 tonnes per year, contributing to the Philippine's status as the world's second largest coconut exporter (Watson *et al.*, 2015)(**Figure 23**, **Figure 24**). The sharp drop in coconut production in 2013 was due to the severe Tropical Cyclone Haiyan, which destroyed an estimated 33 million coconut trees.

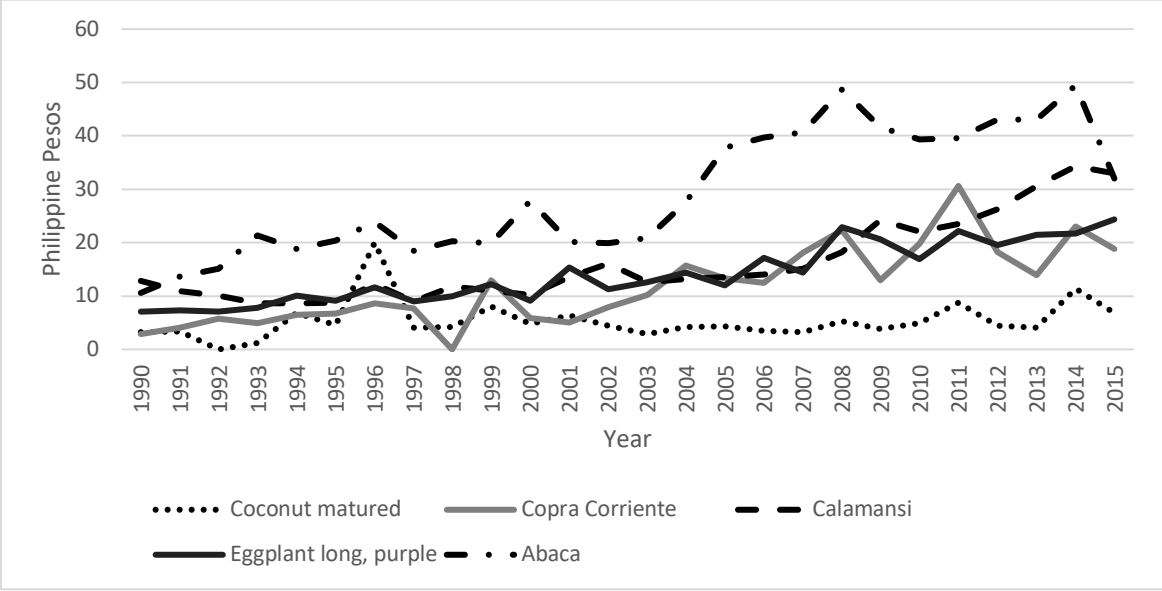


Figure 23: Leyte farm gate price for key commodities produced by smallholders (PSA, 2017)

[13] Municipality is the equivalent of the anglosaxon concept of a town.

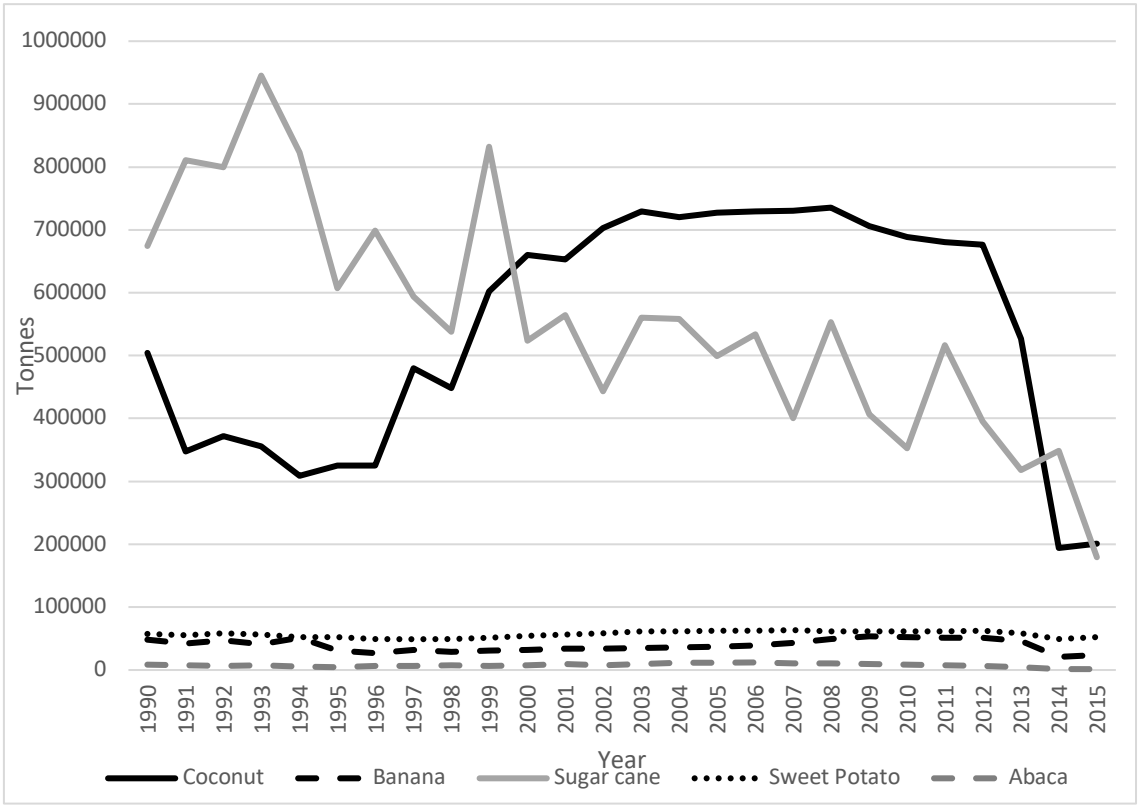


Figure 24: Leyte major commodities produced (PSA, 2017)

Nationally, the coconut industry has been supported by the Philippine Coconut Authority. This Government Authority is responsible for maintaining the coconut industry in the Philippines and support both large scale plantations and smallholders. They extend knowledge to farmers and provide seeds, technical support, and fertilizer, however extension programs tend to focus on the major coconut producing areas, making it harder for more remote farmers to access the support (Rodriguez *et al.*, 2007). The coconut industry has strong influence over rural landscapes, with government support for materials and agricultural input subsidies encouraging smallholders to continue to plant coconuts (Adam, 2013; Rodriguez *et al.*, 2007). In Leyte, the coconut value chain includes a series of private buyers in the main town, who sell raw or processed copra to larger industries in Ormoc, the largest city in Leyte. If farmers have sufficient capital, they build brick 'ovens' to value add the produce and sell copra at a higher price. Copra is then refined and used to produce coconut oils and essences. The average size of smallholder farms is two hectares, in line with global average, and are made up of coconut, rice, or corn crops mixed with home vegetable gardens. Raw coconut is the most commonly sold commodity, as farmers do not have value adding facilities to burn and process the coconut into copra. The Inopacan development plan seeks to increase productivity in the agricultural sector, as this is expected to increase household incomes and curb food insecurity (Inopacan Local Government Unit, 2012). The dependence on income from coconuts provides a context to explore how market food security and alternative food sovereignty discourses are embedded among smallholder experiences of agricultural systems.

6.3 Field work and thematic analysis

Case studies are useful for drawing links between the detailed case and wider policy or theoretical developments, providing transferability of the analysis to different contexts (Creswell, 2007; Flyvbjerg, 2001; Yin, 2003). For situating case studies in wider literature, frameworks enable the diagnosis of core variables in a system that helps answer the central questions being asked (Ostrom, 2010). Semi-structured interviews were used in this study to identify how individuals or groups perceive a particular issue. Semi-structured interviews can be used to elicit perspectives of theoretical concepts in academic literature (Creswell, 2007; Hay, 2008; Saldaña, 2015), in this context food discourses. Using semi-structured interviews can help document voices frequently left out of agricultural development policies and analysis. Prior to data collection, two scoping studies were conducted in November 2014 and June 2015[14]. The scoping involved discussing with university researchers, policy makers, and farming organisations to capture common interests in addressing food and nutrition security in the Philippines. These discussions, along with frequent discussions with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), and researchers from the University of the Philippines Los Baños and Visayas State University confirmed that our semi-structured interview protocol (detailed below) contributed to growing efforts to document the value of systems frameworks for developing transdisciplinary programs in the Philippines, and more broadly, Southeast Asia (Davila *et al.*, 2018).

The semi-structured interview sought to elicit discussions on the socio-economic and demographic profile of farmers, experiences and definitions of food security, visions of what they perceived as a food secure food system, experiences of environmental change, and interactions with government and training bodies. Food security in the interview guide was framed at the household scale, as smallholders in the Philippines remain largely dependent on agriculture for their immediate food security. Semi-structured interviews allowed a fluid conversation to be carried out with smallholder farmers in the field. The interview protocol provided a heuristic device for the researcher to guide conversation along the major themes, with farmers openly talking about their experiences. A total of 39 interviews were conducted across nine barangays over a three-week period in July 2015 (Table 17). Interviews lasted between 20-70 minutes, and were often conducted at farmers' homes or in the barangay hall. Courtesy calls and often lunches with barangay captains were held to inform them of the project and how it linked with Philippines initiatives to increase smallholder perspectives in research processes. Interviewees were informed of the research project, and given cultural appropriates relating to literacy levels and power

14 The 2014 scoping study included conversations with researchers, farmer groups, and farmers in the greater Manila region, Los Baños, Subic Clarke, and Isabela. The diversity of people spoken with narrowed the focus of the study to exploring the experiences of food insecurity. In 2015, a 1.5 day workshop was help with researchers and policy makers from the Philippines to confirm the value of systems approaches to study food security in the Philippines context.

inequalities between participant and researcher, verbal consent was sought. The option to withdraw from the study was emphasised, and they were informed that the reporting of the interviews would be de-identified. Interviews were conducted in the local Visayan dialect with the assistance of an interpreter with proficient English, facilitated through the university networks. Interviews were recorded with verbal consent and transcribed on the day immediately after the interviews, and organised along the lines of the interview protocol. These were then discussed with the interpreter to ensure the right interpretation was captured in the transcripts, as much as was possible. Furthermore, a report back visit was conducted in January 2017 to exchange initial findings and progress on food systems projects being undertaken by the lead researcher and partner universities. The audience for the report back included farmers from upland villages, extension officers, university researchers, and local government unit members.

Table 17: Overview of smallholders interviewed

Barangay	Age range	Number of males interviewed	Number of females interviewed	Farm size range	Number of farmers with additional non-farm livelihood
Can-angay	40-61	1	3	1 hectare	None
Cabulisan	45-67	2	2	1-8 hectares	1 male driver
Caminto	40-74	3	2	1-5 hectares	1 female care worker
Guinsanga-an	47-65	3	2	0.25-2 hectares	1 female occasional coconut wine maker
Hinabay	49-65	2	2	1	3 farm workers, 1 male owns a shop
Jabulisan	36-62	2	2	0.5-2 hectares	1 male driver, 1 female farm worker
Linao	43-61	1	4	0.3 - 4	1 female on honorarium from past council work
Macagoco	53-77	0	3	0.5 – 1	None
Marao	36-79	3	2	0.25 - 5	One family member makes wine

After transcription, data was imported into the analytical software MAXQDA Analytics Pro (VERBI Software, 2018). Thematic coding was conducted using both inductive and deductive techniques, allowing for both issues raised by farmers and my own theoretical perspectives to inform results aligning to the human ecology framework (Braun and Clarke, 2008; Ryan and Bernard, 2003; Saldaña, 2015). A three-stage coding structure, were individual codes (stage 1) were organised into nodes (stage 2) and then meta-nodes as per the human ecology variables (stage 3). Initial codes were identified through the author's theoretical foundations of the food security, food sovereignty, and food systems literature, allowed for various codes to be identified.

Coding strategies followed by individual researchers are based on epistemological and ontological assumptions all researchers hold, so following a logical structured method to link diversity of perspectives the human ecology framework helps document how results were synthesised (Braun and Clarke, 2008; Creswell, 2007). These nodes were then organised into the meta-nodes of the human ecology framework, with a clear focus on market food security and food sovereignty discourses as they were the focus of analysis. Frequency of nodes present in the raw data have been summarised in the supplementary material. However, as this study focused on stories and narratives, the frequency of nodes act as an indication of how common a theme was, yet the value of linking raw data to an analytical framework and literature debate is in linking empirical observations with conceptual tensions, in this case the food security-food sovereignty discourse debate. After the coding was completed, a series of code relation tables which were interpreted analytically using the four variables in the human ecology framework (Davila and Dyball, 2018; Dyball and Newell, 2015). The resulting output were two diagrams of the dominant market food security and alternative diversification discourse embedded within smallholders' interview responses. These diagrams are used in the discussion to situate the findings within agricultural development research.

6.4 Results

The first set of results present narratives associated with how the farmers perceive food security. This includes narratives of both their experiences and their visions of how food security could be improved. The second set of results relates to how farmers perceive the role of government institutions, farmer organisations, and social status in accessing training and support. The third set of results focuses on farmers' perceived interventions for improving their immediate household's food security.

6.4.1 Market food security discourse

Both men (M) and women (F) conceptualised food security as existing when there is sufficient output from staple commodities, notably coconuts, to generate income. This conceptualisation amplified the desire to preserve the current behaviour of the system, stating that "*I would like to produce more of the same crops that I have*"(M); and that *"the way of fixing this [food insecurity] is to plant more! More coconuts, more crops, can increase my food security. The more the better*"(M). The direct association of income with ability to feed themselves and their families indicates that food security is framed in economic and market terms. Maximising production was perceived as being the major driver of food security, as it was assumed to lead to increased incomes: *"For me, food security means planting more. If we don't plant more then we cannot make an income because we just consume what we plant"(M).*

Without increasing coconut plantations or diversifying to other crops, income was perceived to be at risk, threatening long term food security: "*Low income is the worst issue for farmers here.*

This is caused by low yields and poor production of what we grow. I only produce one thing but diversity would be good"(M). Sources of income diversification through non-farm activities were also linked to food security. For example, a 47 year old who also worked as a carpenter said: *"people are always looking at other ways of securing income so that farming is not the only income – we are trying to diversify"(M)*. This same farmer also stated that despite alternate incomes, food security was hard to achieve: *"Food security, to me, is working hard and doing difficult jobs to meet your needs. The basic commodities we need to buy are expensive. It is hard for me to be food secure"* A female farmer said that: "*the reality about food security is that we worry from day to day. Most of the food we buy. The daily needs are affected by whatever available money we have. We choose what we eat based on the money we have at one point"*(F).

Smallholders associated the inability to influence value chain prices with poor food security outcomes. For example, one farmer responsible for extending knowledge to other farmers said that they "*have no control over the market, but all we can do is make a product that is of higher quality. However no matter how good our product is we cannot control the price at the market. The merchants have the power..."*(M). Similarly, one farmer said that "*the major risk for farmers here are the merchants… it is those that have the money that dictate the price"*(M). A female emphasised the separation between them and the value chain, saying that they *"don't know the value chain very well – I just sell it. I don't care what the end of coconut, as long as I get my money for my products"(F)*.

Adoption of higher value crops such as ginger and purple yam, where skills and resources were available, also dependent on the merchant's power in the value chain. One farmer said that "*if merchants do not buy the ginger then we cannot do anything"* (M). That same farmer has an active leadership role in his barangay, where he extends support to other farmers. He has had the personal capacity to convert one-quarter hectare to ginger on his property. This male farmer told the story of acquiring the knowledge, skills, and resources to produce ginger:

"I have been farming ginger for one year. I started planting it because somebody nearby was doing it, so I was able to see what they were doing and transfer the knowledge to my farm. Ginger is a very resistant crop to wind, and is less expensive to run as a farm product. I have been able to convert ¼ hectares to a monocrop of ginger. I have had my first harvest already, but I am trying to double the area.

Ginger has a promise to hopefully boost my future. I did not have major issues in producing ginger. It was initially expensive to set up my ginger area. The land clearing and planting materials where the most expensive for me when planting the ginger. I used to have abaca (banana) here, but I got rid of it to plant the ginger. I asked my friend for money, and I am not in debt." (M)

A different high value commodity perceived to be a good source of future income was purple yam, however the lack of merchant demand for it made farmers stop growing it. One female

farmer narrated the story of purple jam, which received support from an international non-government organisation to train and provide resources to farmers: *"we used to have purple yam, we were given the product, but it did not sell in the market – no one wanted to buy it. This barangay is known for it, but people stopped planting it because no one was buying it. We were very good at producing it, the Barangay hall was full of it."(*F). The lack of power to influence merchants, desire to diversify to crops but being dependent on merchant demand, and food security outcomes being linked to higher incomes presents a situation where smallholders are passive agents in their agricultural system. The social structures of these rural systems, where merchants, more powerful individuals, and local extension agencies can shape agricultural practices, creates implications for increasing the sovereign capacity of smallholders to enact their visions for diversification.

6.4.2 Institutions and food security

Smallholders perceived the role that local government institutions have in supporting farmers in achieving their food security. At the barangay level, the local extension officer is responsible for linking farmers to the local government unit in the main town as needs arise. Government in this context was referred to be the Inopacan municipal office, with one farmer highlighting that *"national agricultural policies are not the most relevant, it is the immediate municipal and provincial policies that affect us"*(F).

There were varying perceptions on the role that public institutions play in supporting farmers' food security. Farmers noted the role of government in providing support in the form of seeds, planting material, and training. One said that *"whatever problem I have in my farm, I can go to the local government to get advice and ideas to deal with problems"* (M), and "*there is a good relationship between farmers and government, especially when the government is providing farm inputs"*(M). There were contrasting views, with some farmers not seeing governments as accessible to farmers. One smallholder stated that she is *"hesitant to go to the government for help"(*F) while another noted that "*it is up to the officials in the community to look for ways to help farmers. Farmers are powerless to do things"*(F). One farmer reflected on how he struggles to access government support, stating that *"for me, there has been no support from government. Maybe it is because I have a very small farm, so it is hard to get noticed."(*M).

The type of support provided by institutions confirmed the historical legacies of a strong coconut governance industry, aligning with the cash commodity policies embedded in Philippines macro-economic development (Davidson, 2016; Davila, 2018). The Philippine Coconut Authority maintains their presence through providing planting materials, fertilizers, and anything to preserve coconut plantations. One male farmer, leader of a People's Organisation in the area noted that "*the Philippine Coconut Authority pays people to plant more coconuts and gives us free fertilizers. Planting materials are free, we just have to plant coconuts"*(M). The local government offices also played a role in supporting access to materials, chemicals input and

fertilizers for coconut crop maintenance. Access to these services was however hindered by the individual farmers' social capital and networks within the community – creating local inequalities in access to services.

Farmers with stronger association with farmers' organisations or other social networks influenced their ability to engage with policy processes and access agricultural support. A female council leader noted the preference she got over others in engaging with institutions: "*Because I was a councillor I had access to training services. I was able to apply this training for my farm"*(F). There was an implication that there are different levels of access to support from formal agencies and from the barangay agricultural extension officer, for example: "*Farmers that have access to the extension officer are luckier because we are given more attention"(M)*. Another farmer supported this view related to improving access to agricultural inputs to expand cash commodity production:

"There is little support from the government for intercropping skills. I would like it if the government could give us fertilizers for coconuts and pineapples, but I am disappointed because the government often helps those that they are close to. It would be better if there were fertilizers for everyone. The government only supports those that are connected. It is the lucky ones that are in a position to get government support. Farmers that don't hold office [in a formal organisation] don't get much support, especially if they are far away." (F)

Interviewees pointed to farmer-led organisations as enabling them to access formal government processes. Farmer organisations are common in the Philippines, and are legally recognised entities that give farmers bargaining power in their municipalities. One farmer stated that "*farmers that are members of a people's organisation are the ones that can benefit from the training. If a farmer is not a member of an organisation, there is a very small chance that they can get training."* (F). Another farmer noted that *"in order for farmers to address these problems, they need to organise themselves to go and ask for help. If they are organised they can ask for help from the local government unit in the town"*(M). These organisations can leverage access to extension services and training that farmers perceive will benefit their production practices. One farmer noted that: '*The procedure is that we usually go to the office, ask for training, and the municipal office then goes to the provincial office to get a trainer that can come and train the farmers"*(M).

The results on institutions shows that even though there are divergent views on the extent to which government is accessible, the discourse embedded in the quote identifies the perception of government officers as fundamental in providing extension and support services to smallholder farmers. Marginalised farmers, either geographically or socially, face challenges in accessing institutional support services, eroding opportunities for agency and sovereignty over their landscapes. Formalised farmer organisations are a common institution in the Philippines to generate greater access to government services, such as training. The extent to which organised farmer institutions would amplify current agricultural practices or could leverage diversification

towards higher value commodities indicates linkages between both market food security and sovereignty discourses in this case study.

6.4.3 Interventions to improve food security

There were a set of perceived interventions to improve food security through increasing incomes while diversifying production, pointing towards the diversification components of food sovereignty being present in these landscapes. Diversification, however, was desired as a way of continuing to engage with markets and value chains, continuing to frame food security outcomes within a market food security discourse. Although coconut production remained a priority for improving incomes, farmers were cognisant of the limitations of the coconut market: *"The coconut is very cheap, so it is hard to make an income. Copra is a main product for us here"(F)*. To overcome possible gluts of coconut oversupply to markets, coupled with the difficulties in negotiating price with merchants, farmers discussed expansion into commodities. Livestock and poultry were presented as costly but potentially high return, with a farmer noting that *"if funding was given to the barangay, I would like to see more livestock, carabao, goats. This would be better for our income*." (M). Diversification into other crops and home gardens was also discussed: "*Planting fruit trees is a way of making more money, but there are no available materials to do so. I would like to plant fruit trees but I can't"* (F). There were tensions between the desire to diversify the types of commodities produced with maintaining banana or coconut commodity production systems. For example, one farmer noted that "*coconuts occupy the land so we cannot plant there, because of plant competition for resources and sunlight"(M).*

Another intervention related to maintaining coconut crops. Pest control was perceived to be a major barrier to food security, as it was reported to heavily affect crops. For example, one farmer (M) noted that *"100% of [coconut] trees are affected by pests insects in this area… the plants still bear fruit, but the yields are much lower*". Extension activities focused on pest control were perceived to have positive influence on land practices, with one farmer saying that they had *"tried the knowledge from the training and it [had helped the] farm"(M)*. Financial assistance is a barrier for accessing pest control and can trap farmers in debt cycles and amplify food insecurity, noting that *"the major issue for farmers is getting financial assistance and pest control. Most of the farmers here own money to someone just to finance the farm. Farmers depend on creditors, and they can never catch up in paying back, so they keep accumulating debt"(M).*

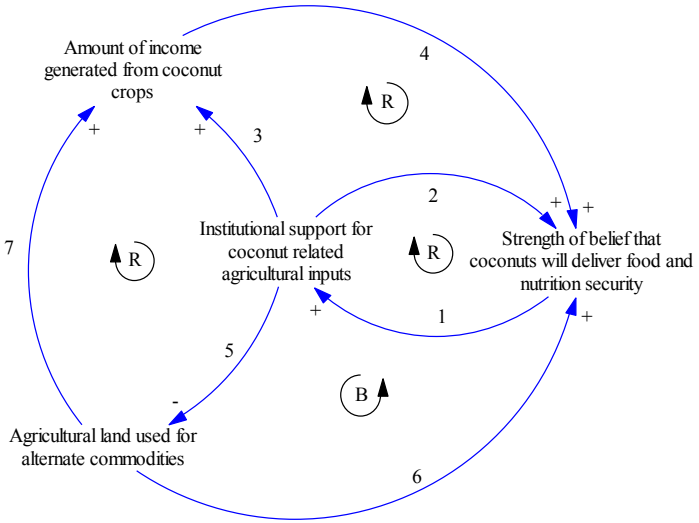
Fertilizer access was perceived as a barrier for achieving food security: *"The type of things that would increase our livelihoods would be fertilizer support, we are dependent on fertilizers to increase production"(F).* Lack of income was attributed to preventing access to fertilizers: *"Having money for fertilizers would have been good for our [coconut] production, it is the main kind of support we would like to have. How can I buy fertilizer if I don't have money?"(F).* Although agricultural inputs are supported through the Philippine Coconut Authority, farmers without adequate links to government of farmers organisations have trouble accessing the inputs.

As one farmer summarised, *"[we] feel insecure when the production is very low. Because of monetary constraints, we have low access to fertilizers sometimes. When we don't have enough funds to buy fertilizers we feel in stress. We need to use fertilizers to maintain our production"(F).* Despite desires and understandings of the benefits of diversifications to increase incomes, this continued to be frame within a market food security discourse that maintained dependence on external chemical inputs and dependency on merchants. While diversification may offer opportunities for aligning with the agroecological roots of food sovereignty, the wider institutional constraints and market discourses present in the Philippines prevent smallholders from enacting this diversification practices.

6.4.4 Synthesis into human ecology framework

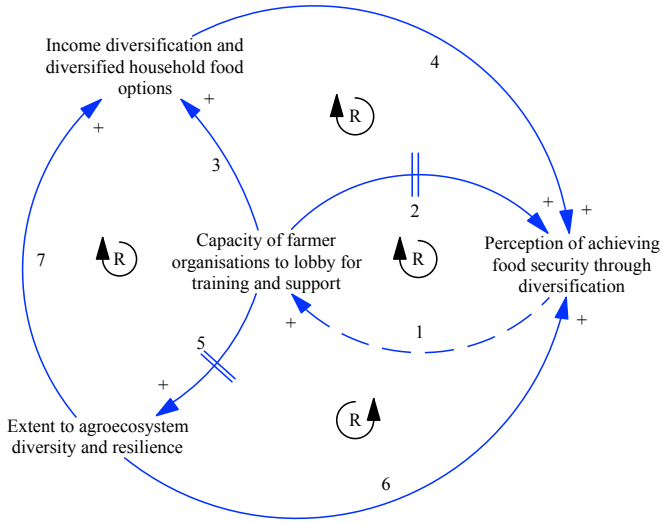
The narratives presented above present diverse experiences of food security and food sovereignty among smallholder farmers. The human ecology framework allowed for a synthesis of how these experiences fit within two ways of conceptualising the current state of agriculture in Inopacan, Leyte. The visual schemas are presented in **Table 18** and **Table 19** as 'snapshot' of two different discourses that are present among smallholders. **Table 18** visualises how the state of the system is geared toward maintaining a cash commodity agricultural system where food security is achieved through engaging with markets. Contrastingly, **Table 19** presents the presence of a food diversification discourse, articulated as a way of improving food security. Both figures enable a discussion on the dichotomous relationship between market dependency and diversification in smallholder systems as components of wider issues in the fields of food security and food sovereignty discourse.

Table 18: The human ecology framework and a market food security discourse in Inopacan, Leyte



Arrow number	Process represented by the arrow
1	There is a framing of food security as ideally achieved through the sale of cash commodities, in this case coconuts. As this belief increases, so dos the institutional support for coconut crops. The rigidity of institutions makes it easy to trap the system into a reinforcing feedback loop.
2	The sustained institutional support for coconut production amplifies the discourse that food security is achieved through commodity production. Institutional rigidity prevents alternate discourses from being acted on, such as diversification.
3	As farmers receive institutional support for coconut, they believe their amount of income can also increase. While coconut farm gate prices have increased, farmers remain trapped in producing low value commodities and are constantly seeking to increase their income. Visions of diversification are not enabled due to lack of institutional support.
4	While farm gate prices have slowly increased through time, they remain low. The perception that it is producing more of the same commodity to generate more income amplifies the belief that coconuts will deliver food and nutrition security outcomes.
5	As institutional incentives promote coconuts, any remaining available land goes unused, or gets planted with more coconuts. The landscape remains simplified as a coconut plantation, reducing opportunities for produce diversification.
6	Given the landscape has been historically dominated by coconut, this reinforces the belief that those coconuts can deliver food security outcomes for the system.
7	The inability to change their practices towards higher value commodities traps income options for smallholders, continuing to rely on coconuts as the main agricultural income source.

Table 19: The human ecology framework and food sovereignty discourse in Inopacan, Leyte



Arrow number	Process represented by the arrow
1	This is a weak link. The weakness comes from farmers knowing that even though farmer organisations can lead to more training and support, their social-status determines whether that can lobby. Even if they can lobby for training, the presence of the coconut industry prevents additional training and resources from being allocated for alternate crops, unless it fits within current coconut programs. Institutions have historically had policies that prioritise staple commodity food systems.
2	As farmer organisations lobby for alternative training, the discourse of crop diversification amplifies. However, there is a time delay to amplify the discourse. The delay is caused by the institutional reluctance to support farmers in diversifying their crop systems to alternative crops.
3	The growing capacity of farmer organisations to stimulate diversification strategies amplifies the ability of farmers to diversify their income. This breaks the dependence on single commodities as the main source of income for families. If food security remains cash based, families now have greater opportunities for incomes through alternate products.
4	As household's incomes become less dependent on a single commodity and more dependent on a diversity of products, families have greater access to subsistence product and tentative additional income. This reinforces the perception that food security is greater as more income is generated from selling different food products.
5	This is a delayed feedback process. As farmer organisations increase their lobbying power and enable farmers to diversify their production systems, agro-ecosystems begin to change. This is a slow process – it can take decades for largely mono-cultured systems to recover lost soils, water retention capacity, nutrients, and micro-biota. The slow changes would being to recover Philippine unique ecosystems, and provide diverse food products for households.
6	Increasing agro-biodiversity provides households with a diversity of products for markets and self-consumption, and a buffer to intense weather events. This amplifies the discourse that food security is more achievable through diversification, through having more products and being more resilient to potentially crop-destroying weather events.
7	As the agro-ecosystem diversifies through multiple crops, farmers are able to sell different produce at different times. This diversifies the income, and reduces the risk of now having income if certain crops fail. Crop diversity can offer financial buffers and create additional subsistence household products.

6.5 Discussion

The three main findings from smallholders' experiences of food security and interventions were: the framing of food security as being dependent on cash commodity production and purchasing power (1), the institutional and socio-political environment that enables or inhibits smallholders' food security (2), and the perceived interventions to improve food security (3). Using the human ecological framework, in this discussion I situate smallholders experiences of both market food security discourse and food sovereignty diversification ideals as dichotomous discourses. Using the visual heuristics in Table 4 and Table 5 in the results, I discuss the understandings and experiences of food security and articulated alternatives in smallholder agriculture systems.

6.5.1 Understandings and experiences of food security

This section answers the first part of our question: *what are smallholders' understanding of their food security?* There is a need to comprehensively document how competing food discourses are enacted by different actors in food systems (Jarosz, 2014). The Philippine case study demonstrated how smallholders associate food security outcomes with income generated from coconut cash crops (**Table 18**, L1–3–4). Despite the fact that coconuts have a low farm gate price, farmers continue to believe that institutional support for more planting and crop maintenance is the solution to increased incomes (**Table 18**, L3). The prevalence of market approaches to food security solutions is unsurprising, given the strong history of institutional support for cash commodity production in the Philippines (Davidson, 2016). In Southeast Asia, policy and private investments have been geared towards mono-cultured high output systems, contributing to the expansion of cash crops in the region (Cramb *et al.*, 2016; Dressler *et al.*, 2016b). This focus on cash commodities was confirmed in this Philippines case study, where the increased belief in incomes led smallholders to continue to engage in coconut commodity systems (L1–3–4). This pursuit of income leads to further land modification, reducing biodiversity habitats and reducing any remaining valuable agro-ecosystem services (L1–5–6) (Wagner *et al.*, 2015). In the Philippines, smallholder farmers have been unable to benefit from the economic gains made in the agricultural sector, with degraded landscapes, complex land entitlements, and high cost of commodity production reducing opportunities for poverty reduction (Cororaton and Corong, 2009; Davila, 2018). While smallholders continue to delivery cash commodities to local and global markets, food and nutritional security outcomes in rural communities remain poor (Adam, 2013; Zamora *et al.*, 2013). This case shares experiences with other agricultural systems in emerging economies, where smallholders continue to provide food to immediate regional trade networks whilst facing poor nutritional and developmental outcomes (Desker *et al.*, 2013; Lowder *et al.*, 2016; Wahlqvist *et al.*, 2012).

Global experiences of smallholder systems show that even when income is generated, it does not necessarily lead to nutritious food choices for feeding families (Burchi and De Muro, 2016; Fan

and Brzeska, 2016). The pursuit of food security through perpetuating cash commodity systems can lead to sustained poverty traps and hunger, with inability of diversifying into higher value commodities or getting adequate returns for products delivered to markets (Borras *et al.*, 2015). For example, it is common for smallholders to face 'hungry seasons' when production is low or market prices insufficient to provide farmers with sufficient income (Bacon *et al.*, 2014). In the Philippines legacies of colonial institutions have created maladaptive policy responses where agriculture extension services are focused on yields and productivity of commodities, eroding any smallholder opportunities for diversifying. These institutional systems can amplify inequality in rural contexts, reduce farmer sovereignty, and acted as a barrier for agro-ecosystem diversification diversify (Borras *et al.*, 2015; Cramb *et al.*, 2016; Dressler *et al.*, 2016b). The macro-economic pressures on national policies to supply cash commodities to global markets perpetuates a discourse of maximising food output for the ultimate goal of food security (Clapp, 2015; Lee, 2013). Without alternatives, farmers have to adhere to the existing system as a way of improving their food security, and are unable to generate smallholder led initiatives that allow alterative discourses or initiatives to be enacted

These stories are shared with smallholders in other parts of the world. For example, in Latin America smallholder farmers that rely solely on export-led food systems have failed to improve their food security status, and have continuously altered landscapes in pursuits of efficiency and cash commodity mono-crops (Altieri and Toledo, 2011). For example, coffee producers in northern Nicaragua faced hungry seasons due to the inability of harvests and market prices to provide sufficient incomes (Bacon *et al.*, 2014), while Isakson (2009) discusses the tensions of relying on market commodities to support, in parallel, traditional production systems. In Malawi, a policy focus on maize and large estates has meant that hunger and poverty remain in rural areas (Kerr *et al.*, 2019). While smallholders continue to face policy pressures to convert to globalised commodities, this market-exist to enable local farmer agency to continue farming traditional commodities (Cramb *et al.*, 2016; Isakson, 2009). Breaking towards new commodities through diversifications, and the institutional barriers preventing farmer agency, situates a co-existing discourse of food sovereignty in this study.

6.5.2 Perceived interventions for diversification and institutional constraints

This section answers the second part of our question: *what are smallholder perceived interventions to improve food security.* The smallholder quotes in the results identified issues of diversification and institutional rigidity preventing alternative agricultural practice from being enacted. While food sovereignty is a very broad concept with multiple elements, the diversification and farmer agency dimensions of it were the ones found to be most present among smallholders. The few that have been able to diversify *and* have agency in their agricultural systems, such as the ginger producer, have done so through their higher social status in the rural system. This creates

challenges for genuine food sovereignty framed alternatives from developing, as the historical legacies of exclusion and marginalisation form food policies will be unable to reach those smallholder with weak social connections in their barangays.

Diversification into alternative commodities demonstrates the dichotomous nature of both discourses studied in their paper. Diversification into vegetables and high value commodities can deliver higher nutritional outcomes for households, and increase incomes through less dependence on cash commodities (Fanzo, 2017; Ickowitz *et al.*, 2019). Diversification can also help create habitat for biodiversity, improve soil quality, and provide income buffers when intense weather events damage particular crops (Altieri, 1995; Wittman *et al.*, 2016). However, diversifying in this case study was still found to be centred around market commodities, so that they could generate more incomes to achieve their own food security. Similar results have been found by Soper (2019), who explains how Ecuadorian farmers have been able to be both agents in their food systems (hence being sovereign) while also engaging with international commodity chains, Similarly, Burnett and Murphy (2014) explain that the local focus of food sovereignty can jeopardise smallholders through reducing opportunities of engaging with more established globalised value chains. The Philippines case contributes to these studies by documenting that smallholders, despite not having high incomes and depending on a single commodity, wish to remain connected to markets and value chains, however they wish to do so through enacting their sovereign visions of diversifying into higher value crops.

Another representation of the barriers for food sovereignty was the embedded socio-political relations within smallholders and their local agricultural institutions. The historical and colonial legacies sin the Philippines have created a social structural system where smallholders remain marginalised from formal policies, and those with adequate connections to land owners can advance their agricultural visions (Davidson, 2016; Davila, 2018; Dressler *et al.*, 2016a). These socio-political tensions can be broken, however they require purposeful organisations and leadership. Examples from the Philippines show that when farmers are able to organise themselves and break from dominant ash commodity systems, they can diversify their food outputs, diets, and have greater sense of control over their food system (Carpenter, 2003; Wright, 2014). In Leyte, developing this institutional dimension of food sovereignty is hindered by the current institutional structures, where extension officers and policy agencies are restricted in funds and capacity. This exclusion of formal institutional structures erodes farmer sovereignty, perpetuating the poverty trap and locking the system into a more dominant market food security discourse, supported by the historically strong Philippine Coconut Authority. Similar studies have documented the implications of historical legacies on how policies have been unable to address inequalities and maladaptive social structures (Montefrio, 2017). The cash commodity systems and land ownership laws set up by colonial legacies have created a highly inequitable food system in the Philippines, perpetuating the notion that smallholders are passive recipients of policy and exist solely to meet market demand of commodities (Borras, 2007; Davidson, 2016; Davila, 2018). Localised tensions amongst villages also create

challenges for sharing food governance in rural settings, as there is frequent competition between farmers themselves to increase their individual wellbeing (Baynes *et al.*, 2016; Li, 2014). The nature of social relations and political connections amongst farmers presents further barriers for equitable food systems, where the less connected will continue to have perceptions of how the system *ought* to be, but will continue to be marginalised from governance processes.

These institutional structures prioritising major commodities are a reflection of the wider political economy of agri-food systems, notably in Southeast Asia which has seen a rapid expansion into cash crops and the ongoing exclusion of smallholders in policy processes (Borras *et al.*, 2015; Cramb *et al.*, 2016; Davila *et al.*, 2018). Despite smallholders' awareness of poverty cycles perpetuated through commodity dependence and value chains, their viewed alternatives towards diversification will continuously be hindered by socio-political institutions that govern their food system. Smallholders are marginalised from governance processes, inhibiting the extent to which food sovereignty processes can gain traction. This in turn inhibits the desired diversification strategies, and amplifies the dominant market discourse and coconut centred food system. Institutional interventions that balance both discourses are thus key to enable farmers to enhance their alternatives within existing governance structures. To break traditional food system behaviours, research and policy interventions need to identify smallholders' capacity to be autonomous in their decision making, and have adequate institutional support to break historically embedded poverty traps (Wald and Hill, 2016).

6.6 Conclusion

Globally, smallholder farmers continue to deliver agricultural produce to meet the demands of growing populations. Despite the expansion of total food output globally, smallholders continue to live in largely food insecure contexts. Food systems are influenced by individual and institutional framings of *how* food and nutrition security outcomes should be achieved, and the human ecology framework presented here provides a conceptually flexible tool for documenting current and future states of the system. Human ecology offers a systems based analytical can guide analysis of how stakeholder discourses exist at one point in time. This paper has qualitatively documented how competing food discourses exist amongst smallholder food systems, and provided a human ecology framework for advancing food systems research. This study has shown that food discourses, identified through qualitative data and a human ecology framework, co-exist amongst smallholder farmers. The food discourses literature has progressed to explore how market oriented food security and the social and environmentally focused food sovereignty can work in parallel to identify interventions in food systems. A challenge remains in exploring how the diversification narratives expressed by smallholders can gain traction, given the strong dominance of historically generated market food security discourse. The integration of qualitative case study research with quantitative methods, such as social network analysis, would allow for more nuanced understanding of the relationships in rural settings that influence agricultural practices and diversification opportunities.

This study, using a qualitative case study, allowed issues of market food security and food sovereignty to be revealed as dichotomous in a specific context. Studying how different discourses can be co-existent at one point in time, and influence the agriculture research and politicise, can help inform more nuanced agricultural interventions for more human and ecologically sound outcomes.

6.7 Supplementary material submitted to Agriculture and Human Values, March 2019

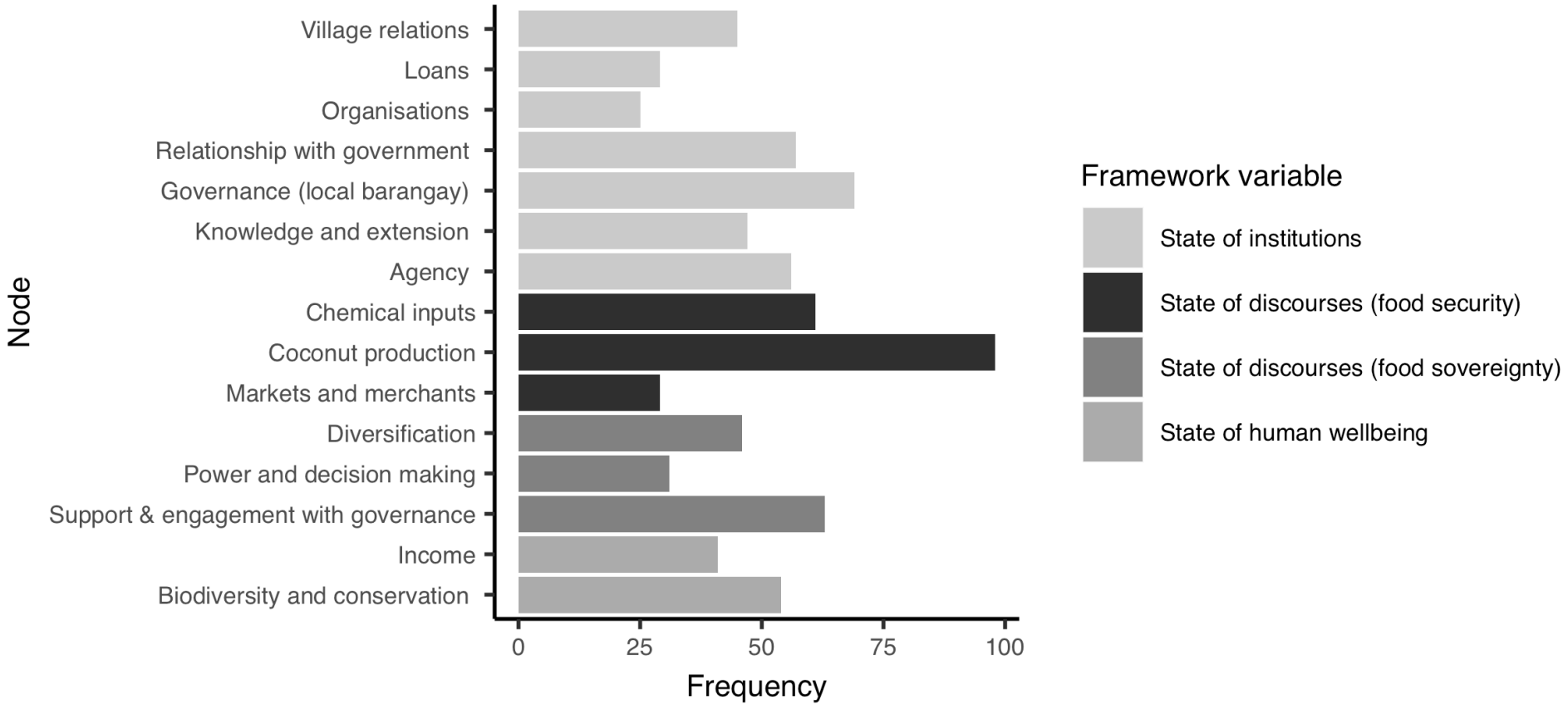


Figure 25: Frequency of nodes present in the total data set from all 39 interviews. A subset of these quotes and nodes are reported on in this paper, presented in Table 1 of the supplementary material. The focus of this analysis was on the State of Discourses and State of Institutions framework variables.

Table 20: Individual quotes as they appear in the results section of the manuscript, with associated codes and meta-nodes allocated during the thematic analysis in MAXQDA.

	Quote used in results	Node	Meta node into framework variable
	Market food security results section		
1	*I would like to produce more of the same crops that I have*	Coconut production	Food security, human wellbeing
2	*The way of fixing this [food insecurity] is to plant more! More coconuts, more crops, can increase my food security. The more the better*	Coconut production	Food security, human wellbeing
3	*For me, food security means planting more. If we don't plant more then we cannot make an income because we just consume what we plant*	Coconut production, Income	Food security, human wellbeing
4	*Low income is the worst issue for farmers here. This is caused by low yields and poor production of what we grow. I only produce one thing but diversity would be good*	Coconut production, Income, Diversification	Food security, human wellbeing, ecosystems
5	*People are always looking at other ways of securing income so that farming is not the only income – we are trying to diversify*	Coconut production, Income, Diversification	Food security, human wellbeing, ecosystems
6	*Food security, to me, is working hard and doing difficult jobs to meet your needs. The basic commodities we need to buy are expensive. It is hard for me to be food secure*	Income	Food security, human wellbeing
7	*The reality about food security is that we worry from day to day. Most of the food we buy. The daily needs are affected by whatever available money we have. We choose what we eat based on the money we have at one point*	Income, markets and merchants	Food security, human wellbeing
8	*Have no control over the market, but all we can do is make a product that is of higher quality. However no matter how good our product is we cannot control the price at the market. The merchants have the power..."*	Markets and merchants, power and decision making, coconut production	Food security, human wellbeing
9	*The major risk for farmers here are the merchants… it is those that have the money that dictate the price*	Power and decision making, agency, market and merchants	Food security, human wellbeing
10	*Don't know the value chain very well – I just sell it. I don't care what the end of coconut, as long as I get my money for my products*	Coconut production, Income	Food security, human wellbeing

11	*If merchants do not buy the ginger then we cannot do anything*	Markets and merchants, power and decision making, agency	Food security, human wellbeing
12	*I have been farming ginger for one year. I started planting it because somebody nearby was doing it, so I was able to see what they were doing and transfer the knowledge to my farm. Ginger is a very resistant crop to wind, and is less expensive to run as a farm product. I have been able to convert ¼ hectares to a monocrop of ginger. I have had my first harvest already, but I am trying to double the area.* *Ginger has a promise to hopefully boost my future. I did not have major issues in producing ginger. It was initially expensive to set up my ginger area. The land clearing and planting materials where the most expensive for me when planting the ginger. I used to have abaca (banana) here, but I got rid of it to plant the ginger. I asked my friend for money, and I am not in debt*	Diversification, agency, knowledge and extension, power and decision making	Food security, human wellbeing
13	*we used to have purple yam, we were given the product, but it did not sell in the market – no one wanted to buy it. This barangay is known for it, but people stopped planting it because no one was buying it. We were very good at producing it, the Barangay hall was full of it*	Diversification, markets and merchants	Food security, human wellbeing
	Institutions and food security results section		
14	*National agricultural policies are not the most relevant, it is the immediate municipal and provincial policies that affect us*	Governance (local barangay), Support and engagement with governance	Institutions
15	*Whatever problem I have in my farm, I can go to the local government to get advice and ideas to deal with problems*	Governance (local barangay), Support and engagement with governance	Institutions
16	*there is a good relationship between farmers and government, especially when the government is providing farm inputs*	Governance (local barangay), Support and engagement with governance, chemical	Institutions

		inputs, relationship with government	
17	*Hesitant to go to the government for help*	Governance (local barangay), Support and engagement with governance, knowledge and extension, relationship with government	Institutions
18	*It is up to the officials in the community to look for ways to help farmers. Farmers are powerless to do things*	Governance (local barangay), Support and engagement with governance, knowledge and extension, power and decision making	Institutions
19	*for me, there has been no support from government. Maybe it is because I have a very small farm, so it is hard to get noticed*	Governance (local barangay), Support and engagement with governance, knowledge and extension,	Institutions
20	*the Philippine Coconut Authority pays people to plant more coconuts and gives us free fertilizers. Planting materials are free, we just have to plant coconuts*	knowledge and extension, coconut production, chemical inputs, relationship with government	Institutions
21	*Because I was a councillor I had access to training services. I was able to apply this training for my farm*	Village relations, governance (local barangay), knowledge and extension, Support and engagement with governance	Institutions

22	*Farmers that have access to the extension officer are luckier because we are given more attention*	Village relations, governance (local barangay), knowledge and extension, Support and engagement with governance	Institutions
23	*Farmers that have access to the extension officer are luckier because we are given more attention*	Village relations, governance (local barangay), knowledge and extension, Support and engagement with governance, agency, power and decision making	Institutions
24	There is little support from the government for intercropping skills. I would like it if the government could give us fertilizers for coconuts and pineapples, but I am disappointed because the government often helps those that they are close to. It would be better if there were fertilizers for everyone. The government only supports those that are connected. It is the lucky ones that are in a position to get government support. Farmers that don't hold office [in a formal organisation] don't get much support, especially if they are far away	Village relations, governance (local barangay), knowledge and extension, Support and engagement with governance, agency, power and decision making, chemical inputs, coconut production, organisations, diversification	Institutions
25	*farmers that are members of a people's organisation are the ones that can benefit from the training. If a farmer is not a member of an organisation, there is a very small chance that they can get training."*	Organisations, Village relations, governance (local barangay), knowledge and extension, Support and engagement with governance, agency	Institutions

26	*in order for farmers to address these problems, they need to organise themselves to go and ask for help. If they are organised they can ask for help from the local government unit in the town*	Organisations, Village relations, governance (local barangay), knowledge and extension, agency	Institutions
27	*The procedure is that we usually go to the office, ask for training, and the municipal office then goes to the provincial office to get a trainer that can come and train the farmers*	Organisations, Village relations, governance (local barangay), knowledge and extension, agency, relationship with government, Support and engagement with governance	Institutions
	Interventions to improve food security results section		
28	*The coconut is very cheap, so it is hard to make an income. Copra is a main product for us here*	Coconut production, income, markets and merchants	Human wellbeing, food security
29	*if funding was given to the barangay, I would like to see more livestock, carabao, goats. This would be better for our income*."	Income, diversification	Human wellbeing, food security
30	*Planting fruit trees is a way of making more money, but there are no available materials to do so. I would like to plant fruit trees but I can't*	Diversification, biodiversity and conservation, knowledge and extension	Ecosystems
31	*coconuts occupy the land so we cannot plant there, because of plant competition for resources and sunlight*	Biodiversity and conservation, diversification, coconut production	Ecosystems
32	*100% of [coconut] trees are affected by pests insects in this area… the plants still bear fruit, but the yields are much lower*	Coconut production	Ecosystems
33	*tried the knowledge from the training and it [had helped the] farm*	knowledge and extension,	Institutions

	the major issue for farmers is getting financial assistance and pest control. Most of the farmers here own money to someone just to finance the farm. Farmers depend on creditors, and they can never catch up in paying back, so they keep accumulating debt	Chemical inputs, income, agency, loans, knowledge and extension	Institutions, ecosystems
34	*The type of things that would increase our livelihoods would be fertilizer support, we are dependent on fertilizers to increase production*	Chemical inputs, coconut production, income, coconut production	Institutions, ecosystems
35	*Having money for fertilizers would have been good for our [coconut] production, it is the main kind of support we would like to have. How can I buy fertilizer if I don't have money?*	Chemical inputs, income, agency, loans, knowledge and extension, coconut production	Institutions
36	*[we] feel insecure when the production is very low. Because of monetary constraints, we have low access to fertilizers sometimes. When we don't have enough funds to buy fertilizers we feel in stress. We need to use fertilizers to maintain our production*	Chemical inputs, income, agency, loans, knowledge and extension, coconut production	Institutions

Chapter 7: Environmental adaptation and co-existing food discourses among Philippine farmers

Full reference: **Davila, F.** Dumaresq, D. (in prep). Cleaning the land and intercropping: Environmental adaptation and co-existing food discourses among Philippines farmers.

In Chapter 6, I showed how smallholder farmers are driven by market discourse to achieve food and nutrition security, yet also wish to pursue diversification strategies to continue to engage with existing market structures. While diversification strategies align with the food sovereignty discourse principles of agroecological production, there are limited demonstrated understandings of the transformative aspects of the discourse. Socio-political structures and dynamics in the rural Philippines perpetuate relations geared towards providing markets with core commodities, limiting farmers' ability to influence any training or policy changes.

As per Table 1 in Section 1.6, in Chapter 7 I contribute towards answering the thesis question: *What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?* Chapter 6 concentrated on the market and institutional dimensions of food discourse. Chapter 7 uses the same data, but looks for the environmental dimensions of discourses. The food sovereignty discourse is strongly associated with agroecological production

prices that deliver a mix of cultural, ecological, and economic benefits to smallholder systems. In this manuscript, I ask the specific question: *How do smallholder farmers frame their strategies to food production in light of environmental change, and how do these strategies align with market food security and food sovereignty discourses?*

Through my human ecology analysis, I found that the discourse of agroforestry and climate adaptation exists among smallholders as an alternative pathway to food and nutrition security. In parallel, smallholders continue to pursue a market food security discourse, as it is one that reflects the market realities in which they operate. Within this market food security discourse, smallholders perceive that 'cleaning the land' is the most suitable strategy to achieve desired food and nutrition security outcomes. I discuss these discourses in light of the food security and food sovereignty discourses, and use systems thinking to show the influence of the discourses on planting behaviour, and the subsequent implication for climate change adaptation.

7.1 Introduction

Globally, smallholder farmers with less than 2 hectares of land make up 84% of the world's farms (Lowder *et al.*, 2016). These smallholders produce approximately 35% of total food output, but are experiencing rapidly changing environments and economic inequality, and (Lowder *et al.*, 2016; Morton, 2007; Ricciardi *et al.*, 2018). Across Southeast Asia smallholders need to meet their household food requirements whilst embracing both a growing regional demand for staple commodities and the effects of environmental change (Dressler *et al.*, 2016b; Lowder *et al.*, 2016; Timmer, 2015; Wahlqvist *et al.*, 2012). Despite increased total agricultural output to meet global market demand, smallholders in Southeast Asia continue to face poor nutritional and human development outcomes (Smith and Haddad, 2015). While smallholders often grow crops for household subsistence, increasingly their main food and nutrition security needs are met by generating income from cash crops to purchase food (Bacon *et al.*, 2014; Cramb *et al.*, 2016). Paradoxically, despite producing a range of products, smallholder farmers continue to have poor nutritional outcomes, and are facing increasing impacts of climate change and land use change (Chaudhary and Kastner, 2016; Wahlqvist *et al.*, 2012). Increasing uncertainty over climate impacts, and the risks of pests and disease and harvest lose, make smallholders particularly vulnerable to increasing climatic variability. To identify context specific approaches to managing environmental change among rural smallholder systems, there needs to be an understanding of how smallholders themselves frame their practices and future interventions to meet food and nutrition security. Understanding how smallholders conceptualise food practices provides an understanding of the extent to which dominant practices can change for improving rural wellbeing.

Capturing these understandings can be done through applying social science frameworks and methods for looking at how human practices influence food activities (Davila and Dyball, 2018; Lee, 2013; Rivera-Ferre, 2012). The political sciences concept of discourses focuses on how underlying ideas influence individual and collective action in particular problems (Dryzek, 1997). Rural studies have critical examined how socio-political relations and economic trends influence rural wellbeing, drawing from the conceptual tools offered by food discourses literature. Two major food discourses influence how food activities are framed and carried out (Davila and Dyball, 2018; Jarosz, 2014). One is market food security, which is often associated with market driven and technological solutions to hunger and climate impacts (Jarosz, 2014; Lee, 2013). The market food security discourse has been typified as supporting the surplus availability of food in markets, but as failing to comment on the equity, power dynamics, and environmental issues associated with high output agriculture (Clapp, 2014b; Clapp, 2017; Lee, 2013). A contrasting discourse is food sovereignty, associated with enabling farmers' voices to surface and form part of what are often otherwise seen as inequitable food policy processes (Akram-Lodhi, 2015; Roman-Alcalá, 2016). Food sovereignty is broadly defined as the ability of people and nations to frame their food system

decisions without dependence and interference from other actors (Wittman *et al.*, 2010). An element of food sovereignty is the increased participation in food decisions and producing food following agroecological principles and culturally relevant practices (Patel, 2009; Wittman *et al.*, 2010). Both market food security and food sovereignty discourses need to be examined as relational to one another and the context in which they exist to advance critical food systems scholarship (Jarosz, 2014). To establish the link between social science methods used and the food systems concept, scholars need frameworks that comprehensively link discourses to environmental and social processes. Human ecology offers a systems-based framework that captures feedback processes between human and environmental variables, and is positioned to advance social studies in food systems and sustainability science (Davila, 2018; Davila and Dyball, 2018; Rambo and Sajise, 1984). Human ecology, as a normative framework concerned with analysing how a system operates (Dyball, 2010), and proposing how systems ought to operate, provides an useful avenue to compare different discourses in rural landscapes.

This study uses human ecology including a case study from the Eastern Visayas in the Philippines to reveal smallholders' discourses on agricultural interventions to improve their food and nutrition security. We asked:

- *How do smallholder farmers frame their strategies for food production in light of environmental change, and*
- *How do these strategies align with market based food security and food sovereignty discourses.*

We first present an overview of smallholder farming in the Philippines as a suitable site to identify how different discourses are understood, and the implication of dominant discourses for advancing rural development in light of environmental change. We then present human ecology as a systems-based framework suitable for understanding how different discourses are present in one site. The results section present to contrasting and co-existing discourses related to managing agricultural landscapes. We proceed to discuss the implications of co-existing discourses for advancing genuine principles of food sovereignty and agroforestry, and the challenges presented by framing perceived alternative agricultural practices within a market food security discourse.

7.2 Case study: The Philippines

The Philippines provides a Southeast Asian country context with a large rural agrarian population that remains food insecure and with poor developmental status (UNDP, 2013). A country of over 7,000 islands, over half of the 100 million people depend directly or indirectly on income generated through the production of key agricultural commodities (UNDP, 2013). Agriculture contributes between 12-20% of total gross domestic product (Cororaton and Corong, 2009). Most farmers are smallholders with average farm size estimated to be 2 hectares. Agricultural policies support the production of cash commodities for domestic and global markets, and farmers are largely dependent on this income for their household's food security (Davidson, 2016; Davila, 2018;

Zamora *et al.*, 2013). However, households that depend on agriculture as the main livelihood are highly food insecure, often facing 'hungry seasons' when food cannot be harvested, commodity prices are low, or climate shocks destroy crops (Reyes *et al.*, 2012). Climate change is manifested through intense weather events and unpredictable seasonal forecasts (de Leon and Pittock, 2016). These changes are rapidly further affecting smallholders' ability to produce food and meet their daily dietary needs. The dominant policy prioritisation towards key market commodities, and framings of food security as a national self-sufficiency issue, create a dominant market oriented discourse that prioritises productivity over human and environmental wellbeing (Davidson, 2016; Davila, 2018). For example, the programs geared towards increasing the production of cash commodities such as sugar and coconut have increased total national output; but these and other programs have been unable to ensure appropriate nutritional outcomes for smallholder food producers (Borras, 2007; Davila, 2018; Zamora *et al.*, 2013). While extensive literature from the Philippines indicates the ongoing power dynamics that prevent rural development policies from being equitable distributed (Baynes *et al.*, 2016; Dressler *et al.*, 2016a; Montefrio and Dressler, 2016), this study sought to first comprehend how smallholders' discourses exist in one landscape, before proceeding to discuss the relevance of these discourses for the socio-political context in which they exist.

The island of Leyte in the Eastern Visayas region is the eighth largest Philippine island (Figure 26), is home to 1.7 million people, and 61.4% of the population depends on agriculture for incomes. From a total land area of 800,000 hectares, approximately 10% remains as forest cover, with most old-growth and primary forest replaced by coconut and abaca plantations occupying the relatively flat land suitable for agriculture (Mukul *et al.*, 2016). The island has a long history of settlement and intense land use for forestry and agricultural products dating back to the Spanish colonial era. In Leyte, elite land-owning families have maximised their use of governance structures and laws that enable them to maintain tenants in Haciendas (large areas of private land) working in intensive commodity production, notably coconut and copra (Dressler *et al.*, 2016a). Increasing agricultural productivity in key commodities remains a major development plan for the provincial government (Leyte), as well as at municipal (town) and barangay (village) level (Inopacan Local Government Unit, 2012).

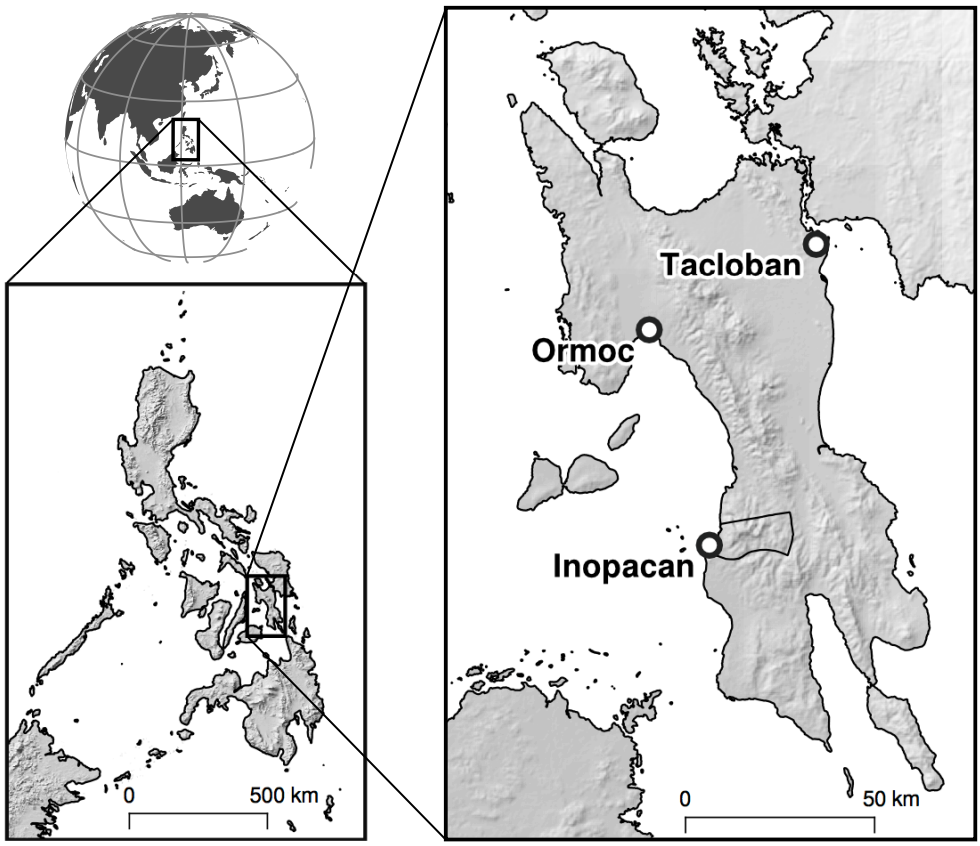


Figure 26: Geographical locations of the Philippines, Leyte, and Inopacan

This study is focussed around the municipality of Inopacan, with 20,000 people in Southwestern Leyte (Figure 27). The municipality has a geopolitical area of 9,699 hectares, and a hilly environment with the highest elevation point at 1000 meters. Inopacan is one of the poorest municipalities in the Philippines, where the average individual income is of USD585 per year (approximately USD1.6 per day). The municipality has 20 barangays[15]: eight are coastal, 11 are upland, and one is an island. The literacy rate is 89%, and school, health services, and markets are physically accessible for all except the far eastern barangays, where poor road conditions make transport difficult during heavy rains. Employment is high, with 70% of the population engaged in the labour force. Agriculture is the main economic sector, with coconut being the major cash crop, and other crops such as banana, camote, and cassava intercropped on some farms. Inopacan has a total agricultural area of 4,107 hectares, of which 3,789 is devoted to planted crops, largely coconuts. Nationally, the coconut industry has been supported by the Philippine Coconut Authority. This Government Authority is responsible for maintaining the coconut industry in the Philippines and supports both large scale plantations and smallholders. The Authority extends knowledge to farmers

[15] The smallest political administrative unit in the Philippines

and provides seeds, technical support, and fertilizer, however extension programs tend to focus on the major coconut producing areas, making it harder for more remote farmers to access the support (Rodriguez *et al.*, 2007). Inopacan's farmers contribute to the Philippine's status as the world's second largest coconut exporter (Watson *et al.*, 2015), but remain among the country's poorest.

Soil erosion is a major problem in Inopacan, with approximately 30% of the municipality's land heavily eroded (Inopacan Local Government Unit, 2012). This is consistent with one of the major environmental issues across the whole island of Leyte, which has severely degraded soils through decades of intensive land modification (Olabisi, 2011). The island has also faced significant forest loss, and is increasingly experiencing severe weather events (Bankoff, 2007). Endemic biodiversity in Leyte remains very rich, however hunting and increased pressure to convert forests for agriculture remain a major threat to biodiversity conservation (Pasa, 2011).

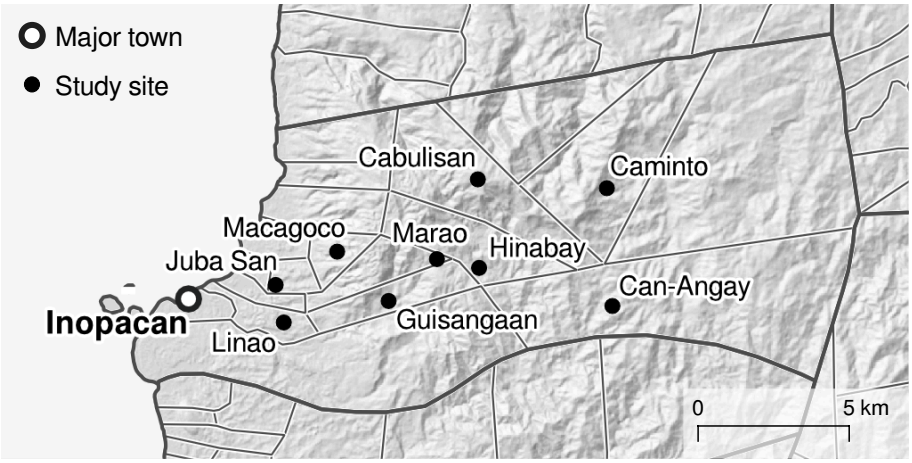


Figure 27: Inopacan barangay distribution and sites visited

7.3 Methods and human ecology framework

Case studies are useful for drawing links between study sites and wider policy or theoretical developments, providing transferability of the analysis to different contexts (Creswell, 2007; Flyvbjerg, 2001; Yin, 2003). Prior to data collection, two scoping studies were conducted in November 2014 and June 2015. These involved discussions with university researchers, policy makers, and farming organisations to capture common interests in addressing food and nutrition security in the Philippines. These discussions, along with frequent discussions with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), and researchers from the University of the Philippines Los Baños and Visayas State University confirmed that our semi-structured interview guide contributed to growing efforts to document the value of systems frameworks for developing transdisciplinary programs in the Philippines.

A total of 39 (20 male, 19 female) interviews were conducted across nine barangays over a three-week period in July 2015 (Table 21). Semi-structured interviews were used as they helped

identify how individuals or groups perceived a particular issue, and could be conceptually analysed using frameworks that contribute to existing research theories (Creswell, 2007; Hay, 2008; Saldaña, 2015).

Table 21: Overview of smallholders interviewed

Barangay	Age range	Number of males interviewed	Number of females interviewed	Farm size range	Number of farmers with additional non-farm livelihood
Can-angay	40-61	1	3	1 hectare	None
Cabulisan	45-67	2	2	1-8 hectares	1 male driver
Caminto	40-74	3	2	1-5 hectares	1 female care worker
Guinsanga-an	47-65	3	2	0.25-2 hectares	1 female occasional coconut wine maker
Hinabay	49-65	2	2	1	3 farm workers, 1 male owns a shop
Jabulisan	36-62	2	2	0.5-2 hectares	1 male driver, 1 female farm worker
Linao	43-61	1	4	0.3 - 4	1 female on honorarium from past council work
Macagoco	53-77	0	3	0.5 – 1	None
Marao	36-79	3	2	0.25 - 5	One family member makes wine

The semi-structured interview protocol was used to ask farmers to define food security/insecurity and experiences of environmental change, which enabled them to talk freely about their current situation. This protocol focused on identifying themes including socio-economic and demographic profile of farmers, experiences and definitions of food security, pathways of what they perceived as a food secure food system, experiences of environmental change, and interactions with government and training bodies. Interviews lasted between 20-70 minutes, and were often conducted at farmers' homes or in the barangay hall. Interviews were conducted in the local Visayan dialect with the assistance of a local interpreter with proficient English. Interviews were recorded with verbal consent and transcribed on the day immediately after the interviews, and organised as per the interview protocol. These were then discussed with the interpreter to ensure the right interpretation was captured as much as possible. A report back visit was conducted in January 2017 to exchange and confirm initial findings and progress on food systems projects being undertaken by the lead researcher and partner universities.

Transcribed data was imported into the analytical software MAXQDA. Thematic coding was conducted using both inductive and deductive techniques (Braun and Clarke, 2008; Ryan and Bernard, 2003; Saldaña, 2015). Inductive codes were created to show specific issues that emerged

from the interviews. Deductive codes were informed by specific topics derived from the food systems, food security, and food sovereignty literature and theory. A second round of coding was conducted to amalgamate codes into higher order nodes, which allowed for the categorisation of codes into variables. A third round of coding was conducted following the human ecology framework (Figure 28) where nodes were situated into the framework's variables: state of ecosystems, state of human wellbeing, state of institutions, and state of discourses (Table 22). Figure 28 and Table 22 show the four major variables used in the third round of analysis, which guided the creation of two systems diagrams, presented in the results.

The framework variables interact with each other through processes that feedback to constrain each variable's behaviour, the interactions represented in the framework by arrows. Each interaction or feedback process can have amplifying (+ sign) or balancing (- sign) impacts on other variables. Links 1, 3, and 5 represent individual and collective activity that function to change the quantity or extent of the variables to which they point. Links 2, 4, and 6 are observation processes whereby the individual or community receives signals informing them about the change in the quantity or extent of affected variables. This may create learning and adaptive change in the dominant discourse, which then would feed back to manifest as new collective action and drivers on the affected variables. Entrenched power and policy resistance may mean the feedbacks are too weak to change the discourse.

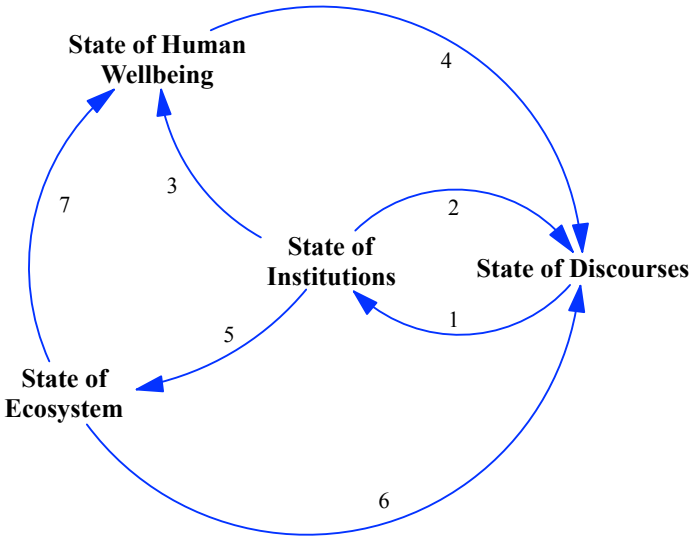


Figure 28: The Human Ecology framework (Davila and Dyball, 2018)

Table 22: Processes in the human ecology framework (Figure 3) explained

Arrow number	Process described by the arrows between variables
1	The influence that a dominant discourse has on generating formal and informal decisions amongst individuals or institutions. This includes planning and goal setting resulting in the design and implementation of policies to promote the dominant discourses in society.
2	As formal and informal institutions learn from experiences, they will either reinforce or change the dominant discourse. Dominant discourses may change or resist change, as other institutions might reinforce it. If they were changed, they would influence the formation of new institutions to reflect the new discourse.
3	This link shows the implications of institutional decisions on individual or community's physical and psychological wellbeing.
4	As communities and individuals change based on institutional activities, dominant discourses may shift, eventually creating new institutional interventions. As with L2, these observations may challenge or reinforce core values, depending on circumstances.
5	This includes collective activities promoted or enabled by dominant social institutions that directly affect the environment.
6	As ecosystems change based on formal and informal institutional activities, new discourses may emerge or dominant discourses perpetuated.
7	Ecosystems are affected by policies and human behaviour, and as ecosystems change they directly affect human health and wellbeing.

7.4 Results

The results below present smallholders' accounts of their farming practices, land management, environmental changes, and the consequences of these for their immediate food security. The analysis using thematic coding and the human ecology framework allowed the identification of two

major themes, reflecting the dominant discourses. The first theme identifies a dominant discourse concerned with preserving current production practices, in particular coconut production. This is linked to the land management practice of 'cleaning' the land. The second relates to concerns about impacts on food security from climate changes and environmental degradation and embodies an alternative food sovereignty discourse.

7.5 Cleaning the land and market food security discourse

The first major activity farmers framed as influencing their food and nutrition security was the continued production of coconuts. 'Cleaning the land', meaning clearing understory and modifying landscapes to maintain cash crops, was present throughout the interviews as dominant language. 'Cleaning the land' for cash commodities was associated with maintaining and improving the productivity of the agricultural system. This productivity enabled farmers to generate incomes from selling the raw coconut commodity. For example, one farmer noted that *"Coconut trees are important – if we don't clean the area they don't give as good a production"* Increases in yield are perceived as the most important aspect of the household agricultural system, as one farmer stated: *"The major agricultural problem for us here is clearing the land to produce more"*. A separate farmer noted that: *"The quality and quantity of product is affected by the 'cleanness' of the farm. We clear the undergrowth to facilitate growth. A clean coconut plantation is more productive…So we need to weed, [we need to] manually clean to maximise our produce"*.

To support this land use practice, farmers discussed how they collectively 'cleaned the land' and sought support from government bodies. One farmer said that they *"have a collective way of cleaning the farm. We share the work in my farm, then we go to another farm to clear it"*. Maximising production was framed as a driver of food security, as framers associated production with increased incomes: *"For me, food security means planting more. If we don't plant more then we cannot make an income because we just consume what we plant."*. The direct link of incomes from commodity production and daily food intake was summarised by a smallholder who stated: "*most of the food we buy. The daily needs are affected by whatever available money we have. We choose what we eat based on the money we have at one point."*

Inability to access adequate labour or materials to 'clean the land' was a barrier for productivity, and therefore a perceived impediment to their ability to generate income to buy food. One farmer said that *"Land clearing and preparing the land are the most expensive things for us"*. Farmers said that *"one of the major support systems for farmers would be financial assistance to clear the land and plant more"* and that *"It would be good to provide financial assistance to the farmers, so they can clean the area."* This support can only be accessed through being part of a government coconut production program that subsidises the commodity production (Adam, 2013; Rodriguez *et al.*, 2007), indicating a crucial role of local institutions in supporting the 'cleaning the land' metaphor as a strategy for food and nutrition security.

Figure 29 and Table 23 present the smallholder perception that cleaning the land is the most suitable strategy to achieve desired food and nutrition security outcomes. It presents the key links and feedbacks that relate to and reinforce this discourse.

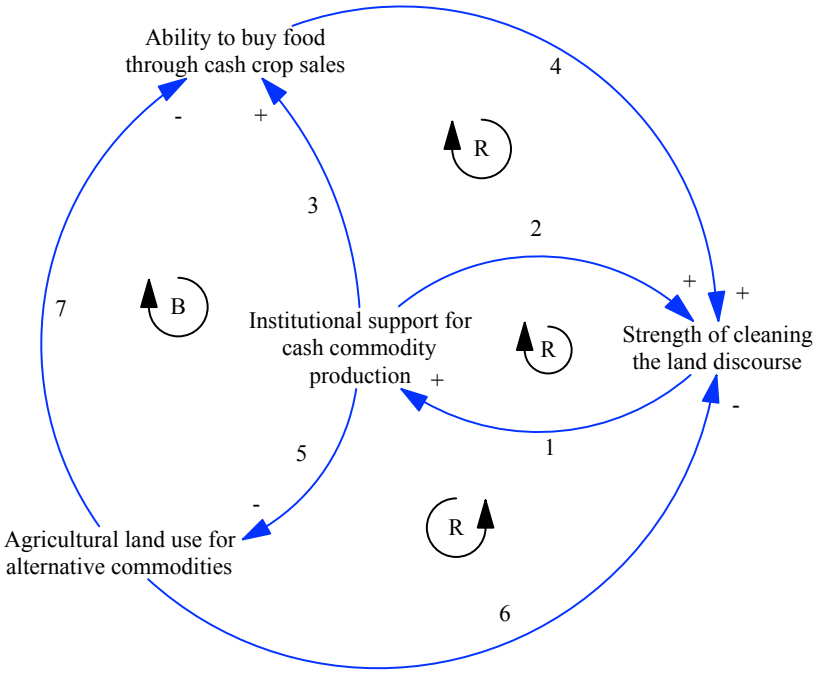


Figure 29: Smallholder's perception of cash commodity systems delivering food and nutrition security. All feedback loops are reinforcing.

Table 23: Feedback processes as perceived by smallholders in Figure 29 explained

Arrow number	Arrow feedback process explained
1	This is a positive link. 'Cleaning the land' is a discourse that drives smallholders to produce cash commodities, in this case coconuts. Increasing productivity requires further institutional support such as subsidies for materials and agricultural inputs.
2	This is a positive link, reinforcing loop between L1 and L2. The presence of institutional support for cash commodities reinforces the belief that 'cleaning the land' is a useful way of managing landscapes which leads to improved production.
3	This is a positive link. The policy support for cash commodities is perceived to support cash income generation from coconuts, which can improve food and nutrition security.
4	This is a positive link. As the perceived food and nutrition security outcomes for households are achieved through selling coconuts, the discourse of cleaning the land for more coconut production is reinforced.
5	This is a negative link. The support for coconuts reduces the available land to plant other crops, such as high value vegetables or trees.
6	This is a negative link. As the availability of non-coconut commodities is decreased through institutional support for coconuts, the discourse of land cleaning is further amplified, trapping L6-5-1 into a reinforcing loop.
7	This is a negative link. As the availability of non-coconut commodities decreases, the food security outcomes also decreases. The lack of available land for non-coconut crops amplifies the belief the food and nutrition security can be achieved through selling coconuts and then purchasing food.

In addition to the positive feedback loops shown in this diagram, some farmers revealed a resistance to changing the current practices due to the history of land use. The presence of coconuts in the Leyte landscape for multiple generations was framed as a barrier to planting other crops, as coconut crops were associated with the identity of the landscape. For example, one farmer said that:

> *"The main problem here is that we don't have an area for gardens, as we have already existing a lot of coconuts and we don't have space for other vegetables. So can you slowly transition to other production systems? No, this is impossible, coconut is much more productive. Coconut has always been here, and it will stay. It is everywhere so we cannot change it".*

Overall, the strong attribution of coconut production to incomes leads farmers to frame the practice of 'cleaning the land' as one suitable to achieve food and nutrition security. This discourse of productivity aligns with the dominant Philippine historical approaches to agricultural development, which have focused on specific commodities (Davidson, 2016; Davila, 2018). These policies have delivered increase outputs for global outcomes, and have influenced how rural land is managed my smallholders who operate in this commodity market system. In parallel to aligning with a commodity driven system, smallholders also demonstrated a strong understanding of alternative

commodity production to deliver mutual benefits of incomes and climate change adaptation strategies. These are presented next.

7.6 Environmental change and adaptation discourse

We found that farmers have experienced major changes in environmental conditions through unpredictable seasons and intense typhoons, loss of reliable water, and degradation of soils. The farmers' experiences of climate change revealed that it is directly influencing their ability to produce commodities, which continue to provide the income to purchase food.

Farmers directly attributed climate change to food security, saying that they *"would not worry if the climate was not changing so much"*. The uncertain nature of environmental change was summarised by one farmer by stating that: "*The Philippines is inverted. Right now it is meant to be raining, but it is very hot. When it rains, it rains hard, and when the sun shines the sun is sunny."* Another stated:

> *"The climatic conditions have also changed. The change of the climate used to be OK, but now it is too random, and there are very intense rainy and sunny periods. These environmental changes have us. There are times we cannot plant because of heavy rains. There are times when we cannot eat."*

As one farmer noted: *"food security for me means that the quantity of food I produce is enough and good, and this is all-dependent on the climate. The climate strongly affects what we do. We are just praying for the right conditions"*.

Uncertain climate patterns were also highlighted by one farmer as affecting their ability to plan their planting strategies:

> *"I think we have had water issues but for about 10 years, but in the past it was easier. We were able to predict the weather and stick with the usual seasons, but now it is much harder to plan accordingly. We knew about it, but we could plan"*.

Increased incidence of typhoons and heavy rains are major problems that reduce productivity. One farmer noted that *"one of the major challenges for me has been the typhoons – adapting is hard. We have a very hard time during the typhoons"*. Another farmer said that *"low yields in coconuts is an issue… we attribute this to the typhoons in the area that keep hitting us… We used to have irrigation systems but they were damaged by the typhoon, so now it is harder to access water"*, whilst another said that *"the impact of climate change on my farm has been largely in heavy rains, which have affected my crops. My crops and vegetables are hit by heavy rain"*.

Environmental degradation of forests was identified as affecting the dependability of springs. One farmer summarised these challenges by stating: *"I have noticed that the forest areas have decreased, as have the water available for us to irrigate. My rice field is thirsty"*. Issues in accessing

irrigation were summarised by other farmer, stating: *"we are happy when it rains, because we can water the crop, but then the rain stops, and it is hot again, and we don't have water. The spring water is not enough to support the production needs that we have, and without irrigation it is very hard to have security".* Another also discussed challenges in accessing water for watering his crops:

> *"Water is a fairly major issue here – irrigation services in the future would be good. If I had to tell one thing about this area, it would be that water is crucial here. But in general, it is that farmers are having a hard time. Water is difficult to access so it would be good to have some more. Sometimes we are lucky, sometimes it is not"*

Soil was another degrading environmental factor that farmers linked to their food production. For example, one farmer said they thought "*that the soil quality [was] degrading in [the] area",* while another stated that they were *"interested in producing high value vegetables but [were] worried about the soil quality".* This quote is also an example of where farmers showed an understanding of environmental adaptation strategies that would also diversify their ability to generate income to purchase food. One smallholder said that *"farmers have to adapt, otherwise it is the end for them. They have no choice but to adapt".*

One adaptation strategy proposed related to the concept of 'shade' for a cooler environment, provided through agroforestry practices. One farmer stated *"to adapt to climate change it would help to have more trees for cooler land, so we are more protected".* Trees other than coconuts plantings were associated with creating buffers and also enabling them to diversify income. As one farmer said: *"planting forest trees would help us to deal with climate change, for shelter. For example agroforestry practices could help us if we got the permits to produce timber".*

Enabling agroforestry and tree planting is constrained by land titles and institutional support for training. For example, one farmer said *"I would like to plant some fruit trees, but I worry because of no land security – how can I plant if I have no security. I want to learn how to plant and keep trees, but I do not have the opportunities."* Similar to the 'cleaning the land' management imperative, formal government institutions were framed as key players in enabling them to develop adaptation strategies and access external assistance. One farmer leader responsible for linking barangay farmers with central agricultural institutions summarised the access to seed and knowledge as follows:

> *"Access to forest trees and fruit trees is also needed. Sometimes there are promises made to deliver seeds, but unfortunately we were not able to deliver the promise. But it is because in Tacloban, the regional office, did not deliver us the seeds. There are promises to support the farmers but there are always disappointments. We make promises to the farmers and we cannot deliver*

because the regional and provincial governments. We put our lives at risk because farmers get angry at us when we cannot deliver."

Access to trees was desired, but not enabled by the economic and institutional structures currently in place. One farmer noted *"regarding climate change, all I can to is plant more trees to protect the land. Trees are beneficial but costly.* Institutional barriers were associated with inequitable access to government services: *"I am hesitant to go to the government for help….Only people listed in government records were the ones that received help. We had minimal help after the typhoon",* and separately that *"The relationship with government for me is OK, but the government cannot support the farmers that are living in very remote areas. But I am an official and I have easier access to the government".*

These farmer views provide examples of different strategies to improve food and nutrition security in light of environmental change. Smallholder approaches to improving food production and adapting to environment change show that they wish to use existing markets and institutions to support their adaption, be it through 'cleaning landscapes' or through diversifying into tree plantations, vegetable production or fruit trees. Figure 30 and Table 24 show strategies aligned with adapting to environmental change and leveraging of markets to sell new diversified produce from tree plantations and other alternative crops. It presents the key links and feedbacks that relate to this discourse.

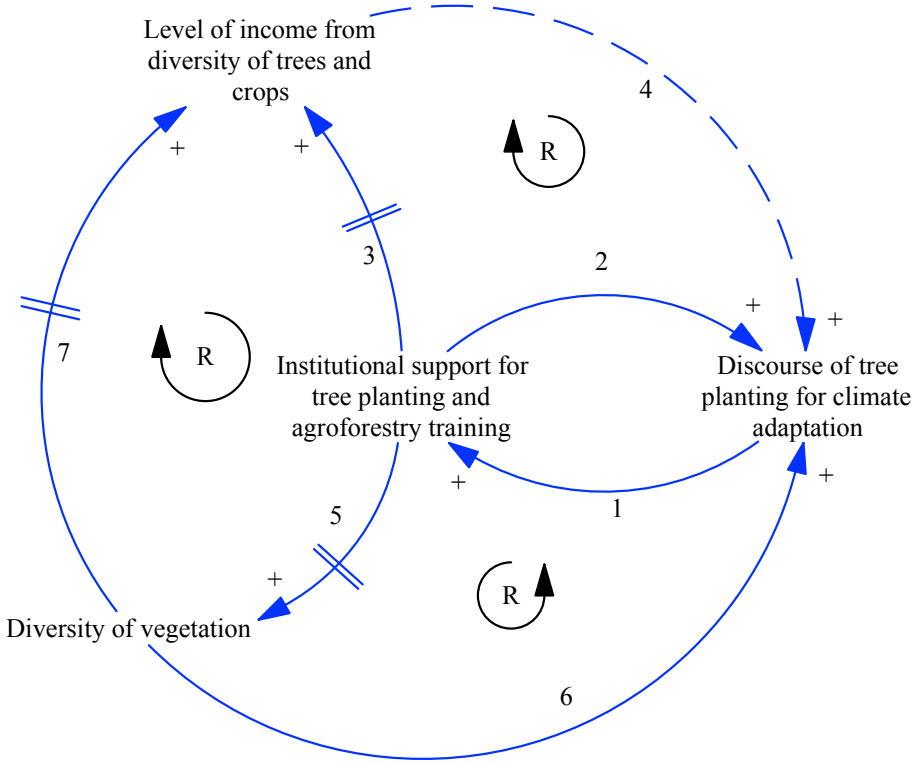


Figure 30: Smallholder's perception of changes in land and environmental management (tree planting for agroforestry, other alternative crops) for income diversification and climate adaptation. All feedbacks are reinforcing.

Table 24: Feedback processes in Figure 30 explained.

Arrow number	Arrow feedback process explained
1	This is a positive link. Smallholder's understanding of changes that can be brought about by agroforestry leads to demand for institutional support for tree planting and agroforestry extension. The discourse here is that such extension will help them diversify income (through timber or fruit trees) and adapt to climate change (through building farming systems resilience and creating physical shelter).
2	This is a positive link. As institutions bring about support for tree planting activities, the discourse of trees in the farmed landscape as a climate adaption strategy is amplified.
3	This is a positive and delayed link. It takes time for institutions to link tree activities to food and nutrition security outcomes. These outcomes are framed as still being dependent on income generated from future tree plantings. As such there will need to be accessible markets for the new products to deliver these benefits.
4	This is a positive but weak link. If food and nutrition security is enabled through the new products from tree plantations, then this will amplify the discourse. However, if no new markets exist, or trees fail to deliver marketable produce, the discourse of trees as an alternative may eventually fade.
5	This is a positive and delayed link. The institutional support for tree planting practices is linked to increased plant diversity on farms.
6	This is a positive link. The diversification of vegetation, assumed by smallholders to be beneficial, will amplify the discourse of trees as an environmental change adaptation strategy.
7	This is a positive link. The perception is that the more diversity of trees, the more diversity of produce. This can lead to diversification of income through selling different products to markets, thus increasing food and nutrition security. Note the smallholder framing of food and nutrition security outcomes is dependent on the income from tree products; not from the nutritional diversity enabled on farm through diversification.

7.7 Discussion

7.7.1 Cleaning the land for food and nutrition security

Through applying the human ecology framework, which looks for linkages between discourses and practice, we found that smallholders engage in the practice of 'cleaning the land' as a pathway to food security, as it can deliver commodities for markets (Figure 29). In parallel, smallholders perceived that agroforestry and intercropping practices could also supply markets with commodities while also offering adaptation strategies to environmental change (Figure 30).

While agroforestry and intercropping present a set of land management practices that align with food sovereignty principles, the way smallholders discussed them in this study continued to align with market driven commodity production. The Philippines has a strong history of export oriented cash commodity policies (Borras, 2007; Davidson, 2016; Davila, 2018). Smallholders have been largely absent from policy processes, eroding any sovereignty they have over their landscapes. Complex land tenure relations, where affluent land owners lease the land to smallholders, have been shown to perpetuate rural inequalities and reduce smallholders' sovereignty over land use practices

(Borras, 2006; Borras, 2007). While supplying markets with stable source of commodities, in this case coconuts, can provide smallholders with incomes, it can also crease vulnerabilities from the uncertainty of global market prices. In addition, the sustained low price of their commodities and tenuous land rights prevent smallholders from fully benefitting from the market (Adam, 2013). One of the responses by the smallholders is to endeavour to increase their productivity and hopefully income is through 'cleaning the land'.

The stories of 'cleaning the land' can be interpreted through the components of the market food security and food sovereignty discourses. Managing landscapes for maximising commodity output creates implications for natural resource management, notably in the Philippines, which remains one of the world's most biodiverse countries. Within food sovereignty, the concept of agroecology focuses on agricultural practices associated with traditional knowledge and smallholder cultural practices (Rivera-Ferre, 2018). The commodification of the Philippines food system has eroded the opportunities for smallholders to apply such traditional practices, augmenting the market food security discourse focus on practices that maximise cash commodity production. This technocratic view of 'cleaning the land' for cash commodities aligns with historical market food security discourses that enabled an institutional focus solely on provision of food without considering environmental impacts (Lee, 2013). The ongoing demand for cash crops from developing countries is estimated to have been a major driver of habitat and species loss over the last 50 years (Chaudhary and Kastner, 2016). Studies from Latin America show that the use of agriculture to create biodiverse habitats can enable farmers to diversify their total food output, and increase biodiversity (Altieri and Nicholls, 2008; Altieri and Toledo, 2011; Nicholls *et al.*, 2016). Previous studies have found that diversity of production systems support genetic diversity, ecosystem services, biodiversity habitat, and opportunities for nutritional diversity (Fanzo, 2017; Frei and Becker, 2004; Horgan *et al.*, 2016). Despite some isolated case studies of sovereign decision making to diversify food production, institutional rigidity in the Philippines means that food and nutrition security continues to be framed as dependent on the production of cash commodities for global markets (Davidson, 2016; Davila, 2018).

7.7.2 Environmental management strategies for climate adaptation

Parallel to the market discourse, Inopacan smallholders perceived the possibility of managing beneficial land and environmental changes in their farmed landscapes through the introduction of agroforestry of mixed-crop production systems (Figure 30). In this context, agroforestry encompasses the planting of fruit or timber trees within existing croplands (here devoted to coconuts). The agroforestry and intercropping discourse shows that farmers also associate the presence of forest trees in their farmlands as adaptation strategy for climate change, which can also deliver broader environmental benefits. Trees provide shelter and buffer to climatic calamities, manage microclimates, increase income opportunities, enhance water and soil carbon storage, and

reduce deforestation rates (Lasco *et al.*, 2014). Given the environmental context of the Philippines, including severe weather events, increasing soil degradation, and unique biodiversity, the use of trees as an adaptation strategy can reduce farmer vulnerability and provide buffers for times when environmental change can affect crops (de Leon and Pittock, 2016; Lasco *et al.*, 2014).

Opening up mono-cultures to intercropping and animal integration can also lead to diversified diets when there is utilisation of knowledge and access to different food produce in markets. Analysis by Frison *et al.* (2011) shows that agricultural diversity can contribute to increased intake of diverse micronutrients, especially among children. Similar studies in Sub-Saharan Africa, Latin America, and the Mekong show that diversity of food produced and accessed by households can have long-term nutritional benefits (Fanzo *et al.*, 2013; Nurhasan *et al.*, 2010; Pittock *et al.*, 2017b; Powell *et al.*, 2015). Thus, the planting of trees in smallholder systems has significant potential in improving incomes, livelihoods, and diets (Luedeling *et al.*, 2014; Steffan-Dewenter *et al.*, 2007).

This co-existent discourse shows that despite the dominance of a mono-cropping discourse, smallholders see intercropping and other agroforestry as a strategy that could enable them alleviate some of the poor environmental outcomes of coconut monocultures, help them adapt to climate change, and assist in achieving their food needs. Capturing this diverse understanding is important, as it can be leveraged as a way of intervening in the existing food system through research and policy programs that target crop diversification.

The development of this discourse as a fully realised alternative to the 'Cleaning the Land' discourse will be hindered by existing institutional structures that prevent smallholders' ability to be sovereign agents in their rural landscapes. There are institutional constraints to seed access, training, and cash resources to plant trees. Previous programs run by the Philippine Government have targeted intercropping and livestock in coconut plantations, but only in highly industrialised landscapes, leaving more remote communities without training and knowledge extension (Rodriguez *et al.*, 2007). In addition, studies in agroforestry in Leyte have found that that smallholders are receptive to extension advice, but such extension materials need to be crafted to suit the particular needs and interests of smallholders (Baynes *et al.*, 2011a; Baynes *et al.*, 2011b; Herbohn *et al.*, 2014). Existing understandings of how to manage trees in agricultural systems may also provide barriers for shifting practices to maximise tree productivity and efficiency. Without an adequate documenting of smallholders' interest and practices, extension activities are unlikely to lead to sustained adoption and behavioural change (Baynes *et al.*, 2011a). Developing these strategies will be dependent on the willingness of extension program personnel to adapt to farmer perceptions, and to address the power relations within rural areas that dictate who accesses resources (Baynes *et al.*, 2016).

The discourse of agroforestry as a way of producing income and adapting to environmental change offers a different insight into how the food system could operate in Leyte if adequate institutional support existed. Food and nutrition security outcomes would depend on smallholders ability to sell fruit or timber from new tree plantings, requiring institutions to provide adequate market links and infrastructure, as well as access to resources such as training and seed stock. The

institutional constraints to seed access, training, and cash resources to plant trees would also require further interventions to enable farmers to implement their perceived adaptation pathways.

The focus on institutions as the main driver for entrenching a particular pathway presents a leverage point in the smallholder food system. In systems thinking, a leverage point enables the application of practical tools that can shift dominant discourses that influence the systems behaviour (Abson *et al.*, 2017). The leverage point exists in using the revealed discourses in this study to design policy and programs that develop one possible pathway over the other where both pathways are present in the farmers envisaging of their future development. Programs aimed at developing the agroforestry and food diversification strategies in Inopacan would benefit from the now recognised benefit and willingness by smallholders to diversity into tree planting techniques. Targeting remote and marginalised communities who believe institutions can help them offers an intervention point. In the Philippines, there is already a strong history of work and expertise in agroforestry within government, research, and industry bodies, and with farmers (Lasco *et al.*, 2016).

The presence of an agroforestry and biodiversity discourse amongst smallholders studied here aligns with the advocacy concerns of food sovereignty scholars for diversifying food production systems. Smallholder sovereignty would be enabled through allowing them to apply their agroforestry discourse.. Allowing farmers to increase their decision making ability has been shown to challenge the dominant market and economic narratives that exist across rural food systems (Altieri and Toledo, 2011; Misra, 2017). This can enable new ways of understanding and framing food and nutrition security solutions, yet can only be leveraged through the active leadership of institutions and extension services tasked with supporting smallholder farmers. Experiences from smallholder settings globally show that challenge remains in breaking the dominant mental models embedded in agricultural institutions to enable new agricultural innovations to be piloted and adopted by smallholders (Davila, 2018; Lowitt *et al.*, 2015; Pittock *et al.*, 2017a; van Rooyen *et al.*, 2017).

7.7.3 Agricultural alternatives within a market discourse

Expanding agricultural systems towards mixed output systems, as found in this study, will operate within existing market structures, and farmers will pursue diversification within a market discourse. Smallholders in this case study see existing markets structures as a means of implementing alternative agricultural strategies rather than opposing them. However, without access to support for planting non-coconut crops, smallholders will continue to operate within the coconut cash commodity discourse that reinforces their current practices, rather than taking risks and investing in new commodities and land management practices.

This study evidenced that even though principles of agroecology were present among smallholders, the political activism and agency supported by agroecology and the broader food sovereignty discourse were absent. The practices discussed by smallholders, rather than offering radical alternatives and enabling political activism, where directly aligned with the market food

security discourse. This presents a challenging context for advancing issues of sovereignty among smallholders in this rural context, as they themselves frame alternative farming practices within an economic and market driven discourse. Ultimately, smallholders in these landscapes spoke about the need to meet food and nutrition security through income. This is understandable in light of the sustained poor human develop outcomes in Leyte, which remain one of the poorest regions in the Philippines. Given the limited rural employment opportunities and poor policy support for alternative production practices, agricultural systems have been locked into a maladaptive state. In such a state, systems perpetuate behaviours that may not deliver long term social and environmental outcomes. The agroforestry and intercropping insights presented by smallholders showed one possible avenue for advancing their individual sovereignty, however even if enabled, this may end up conforming to traditional market food security discourse. These nuance interactions between the choice of agricultural practice and the broader market system in which agricultural products are delivered demonstrate how progressing food sovereignty may fall short and continue to operate within broader market driven food system discourses.

7.8 Conclusion

Understanding how smallholders frame possible interventions to improve food and nutrition security and adapt to environmental and climate change is an important step towards developing research and policy strategies that can improve human and ecological wellbeing. This paper advances this knowledge through revealing how smallholder farmers perceive land management pathways for improving their food and nutrition security. One pathway revealed was through continuing to make land available for cash commodity production, which smallholders perceived as leading to better incomes and therefore increased food and nutrition security. This pathway aligns with the market food security discourse, which focuses on prioritising availability of food commodities for market sale and assumes that cash from sales can be used to purchase nutritious food. The second pathway was through applying agroforestry techniques to build adaptive capacity to cope with environmental and climate change. Farmers also saw this second way as also diversifying incomes through timber and fruit sales. This pathway aligns with debates within the food sovereignty discourse that focus on breaking traditional market driven policies and focusing on diversification strategies held within existing smallholder farming communities.

The use of human ecology as a systems framework revealed that at core, both discourses were seen by farmers as being enabled or hindered through the availability or lack of institutional support. Human ecology offers sustainability researchers a tool for deconstructing complex sustainability challenges into meta-variables that link ecological, human wellbeing, institutional, and conceptual discourses. Given the often market-oriented nature of agricultural institutions, this paper suggests that institutions can use the perceived alternative pathways, such as agroforestry, to diversify current agricultural activities. Local institutions, which continue to focus on market solutions, can be leverage points in smallholder systems. They can enable marginalised voices from being increasing

their influence in policy processes, and increase the participation of smallholder farmers to work towards improved food and nutrition security.

Chapter 8: Synthesis and conclusion

8.1 Overview of findings

In this thesis I have presented five papers at different stages of the publication process. The papers explored the interaction of food institutions and food discourses, using a systems-based human ecology and qualitative research approach. In this final chapter, I answer the overall research question:

To what extent does a human ecology framework help capture links between food discourses and institutional behaviours in food systems?

I do so by providing sections that answer the sub-questions presented in Chapter 1, and answered throughout Chapters 2-7.

Throughout the thesis, I have documented the prevalence of the different interpetations of the discourses that influence how we respond to food and nutrition security challenges. My research has shown that in Southeast Asia, as documented in Chapter 5, transdisciplinary research agendas that wish to include smallholder farmers will be critically hindered by the dominant framings of food and nutrition security as achieved through key commodity production, with farmers as passive recipients of knowledge stemming from policy and research. When I spoke to smallholder farmers in the rural municipality of Inopacan, Leyte, the Philippines, I found that they held co-existing discourses and presented different pathways towards improving their rural food and nutrition security. Some of these were through continuing to produce cash commodities, others through diversifying into high value crops and agroforestry systems. The stories and pathways presented by farmers, discussed in Chapters 6 and 7, confirmed that market and production discourses remain major drivers of food and nutrition security – that is, regardless of what they produce, farmers will continue to seek income from cash commodities. However, for these markets adequately deliver higher incomes and purchasing power, farmers argued for stronger control over the value chain and improved institutional flexibility to expand from existing cash commodity driven support systems. Furthermore, I found in this thesis that institutions continue to be hierarchical and are not providing equitable opportunities for the more marginalised farmers, creating critical challenges for advancing the concepts and practice of sovereignty among Filipino smallholder farmers.

These stories of food challenges come together through the conceptual human ecological analysis on which the thesis is founded. In Chapter 1 and 2, I situated human ecology as a systems-based framework capable of advancing social science enquiry within food systems, notably for the study of the social dimensions of food production. I advanced the human ecology Cultural Adaptation Template (CAT) by embedding political literature of discourses into it, showing how food-discourses literature and socio-historical analysis operationalises the conceptual framework (Chapters 3-4). My analysis shows that the integration of a systems-based human ecology

framework and food discourses literature advances our understanding of the role of institutions and farmers in perpetuating and developing new discourses.

In this unifying and concluding chapter, I present the three major contributions my research has made towards demonstrating the links between human ecology, food discourses, and food systems research. Within each of these three contributions, I answer the individual research questions asked in Chapter 1. The first contribution relates to the Philippine context, and is based on findings from Chapters 4, 6, and 7. The second contribution relates to the implications of the research for sustainable development research and policy, and is based on analysis from Chapters 3, 4, and 5. Finally, the third contribution relates to the methodological developments presented through Chapters 3-7, and demonstrates how this thesis advances the study of social drivers within food systems research.

I explicitly designed this study as an interdisciplinary scholarly piece, bridging sustainability science literature and theories with political discourse studies, through the approach of human ecology. Interdisciplinary research draws from different disciplines to generate new knowledge that could not have been produced in a single-disciplinary way (Haider *et al.*, 2017; Reed *et al.*, 2017). The inevitable nature of food-systems research in developing contexts, such as Southeast Asia and the Philippines, meant I also broadened towards transdisciplinary research, where non-academic knowledge was used with the normative purpose of improving the state of a system (Mitchell *et al.*, 2015). While my analysis was academic, my exposure and collaboration with SEARCA, a boundary organisation, and municipal government actors provided contextual salience and legitimacy to my research. The systems activities and analysis I presented throughout the thesis allowed multiple users to adapt and apply the human ecology framework, and I tested the framework using qualitative data collection methods – something not previously done for the CAT development by (Dyball and Newell, 2015).

As discussed in Chapters 1-3, my study was situated at the intersection of human ecology as a sustainability framework and food discourses studies. Market food security and food sovereignty discourses, which I introduced and analysed in Chapters 1 and 2, provide different propositions on how institutions ought to address the issue of feeding a growing population. Both discourses exist in a relational manner to the context in which food and nutrition security challenges exist, making them highly fluid concepts across cultures and scales. In Chapter 3, I reviewed how these discourses influence institutional interventions and their subsequent effect on human and environmental wellbeing. Literature and historical experiences show the market food security discourse has enabled a focus on commodity production that has managed to meet increasing global demand for cash commodities, but has led to major adverse environmental and social consequences. With little commentary on generating access to food, or asking how and why food is produced in a particular way, the market food security discourse continues to dominate how the problem of feeding the world is framed in research and policy. In contrast, the food sovereignty discourse emphasises processes that lead to hunger reduction, with explicit attention to agroecological food production strategies

and farmer participation in landscape decisions and food policies. Food sovereignty discourses argue that sustainable food system outcomes can be achieved through challenging the dominant power structures that prevent food actors in specific food systems from exercising greater control over their food activities. I explored how these discourses are enacted in different contexts, focusing on institutional responses to smallholder agriculture.

From this theoretical and literature context, the analysis of results and literature led to the following major findings:

1. In Chapters 2 and 3, I presented a human ecology methodological approach for food-systems research. Human ecology offers a research framework that is salient to the current global need to act on human and environmental problems using multi-stakeholder approaches. In Chapter 3, I situated human ecology within the post-normal scientific realm. Post-normal science seeks to develop tools for engaging extended peer communities of actors with stakes in one particular problem. Such communities exist across most, if not all, sustainability challenges, and are made up of different values, cultures, and political systems. Extended peer communities are ones that bring together different knowledge types and levels of influence to change particular ways systems behave. Within my Philippines and Southeast Asian focus, the extended peer community were the smallholders, policy makers, and researchers involved in advancing transdisciplinary research in the region and in producing food for markets. SEARCA, as a boundary organisation linking research, business, policy, and farmers, acted as a magnet for bringing together extended peer communities. My analysis following a three-stage coding strategy enabled me to show how the human ecology framework documents the co-existence of discourses. Two discourses, market food security and food sovereignty, were demonstrated to be embedded in smallholders' understanding of improving food and nutrition security as an outcome of their food system (Chapters 6 and 7). The findings also advance food discourse studies that are yet to explore their synergies with systems thinking and sustainability-oriented frameworks like human ecology.
2. In Chapter 4, I used my analysis of Philippine food systems to show that the market food security discourse has been embedded in a series of institutions established by colonial legacies, and has continued since Philippine independence. I documented how the Philippine food institutions, ecosystems, and smallholder communities are trapped in a maladaptive system where dominant macro-economic focus on cash commodities leads to institutional support for ecosystem degradation and reduced capacity for smallholders to overcome their food insecurity. In concluding Chapter 4, I discussed how Philippine institutions are maladaptive, and lock the system into a particular market oriented discourse. While such systems deliver economic gains to certain actors in the food systems, smallholder systems continue to be inhibited from increasing their

wellbeing and acting as sovereign decision makers in their own food system. I was interested in exploring the extent to which such maladaptive systems existed in rural smallholder contexts, and the extent to which everyday agricultural policy and research institutions influenced smallholder agriculture. One way for me to explore this was through leveraging from SEARCA's plan to advance transdisciplinary research in the Philippines and Southeast Asia. Another way was to interview smallholder farmers in a low-income region of the Philippines.

3. In Chapter 5, I used a systems exercise for capturing the dominant understandings of food and nutrition security held by experts tasked with implementing transdisciplinary food system projects in Laos, Cambodia, Thailand, and the Philippines. From the analysis of participants' system diagrams generated in a workshop setting, I showed that these experts perceived that local government support for training and agricultural extension are the core institutional response required for farmers to improve their productivity, and their subsequent food and nutrition security through increased incomes. In these systems, smallholder farmers continue to be regarded as passive recipients of knowledge and extension. These projects could enable farmers to diversify production practices and produce higher value commodities. However, as colleagues and I discussed (Chapter 5) smallholders continue to be perceived as passive absorbers of knowledge and extension, and not as active co-producers and agents in informing exactly what and how knowledge is provided to them. This indicates that smallholders' roles as active participants in transdisciplinary research and policy is likely to be limited. Participants in the workshop articulated that public policy and research institutions are *providers* of one-way linear knowledge processes, rather than *enablers* of knowledge systems, where smallholders can advocate and test their perceived pathways. This is a striking finding from the analysis, given the ambitious agendas of SEARCA to advance transdisciplinary research in the region.
4. In Chapter 6, I show how Inopacan smallholders see improvements to their food and nutrition security status as solely dependent on income generated from continuing to work within the same commodity production system they operate in; in this case, coconut production. To understand how smallholder producers frame interventions in their food systems, I conducted 39 semi-structured interviews with coconut producers in Inopacan, Leyte (Philippines). I found that farmers invoke both market food security and food sovereignty discourses in how they frame pathways towards food and nutrition security. Within Chapter 6, I discussed three major issues that exist in this coconut production system. First is the policy support for maladaptive agricultural practices. Local Government Units and the Philippines Coconut Authority provide support through fertilizers and coconut-specific extension services. While this is framed as adequate by those wishing to live off coconut incomes, it is considered an

inadequate institutional response by those seeking to diversify their income source through different agricultural practices. Coconuts remain relatively low-value commodities, preventing incomes from being sufficient to meet household food and broader needs. Farmers use income generated from coconuts to purchase food and meet other household expenses. This creates a context for an alternate discourse of diversification and non-coconut production to exist among smallholder farmers. The institutional structures, however, are rigid and do not enable smallholder visions from being acted on, particularly given the political nature of knowledge access. Ongoing policy support in the form of training and access to fertilizer can only be reached by those farmers with local connections to extension officers or government officials, meaning that the most marginalised farmers will remain trapped in poverty as they will be unable to access resources and enact diversification pathways. The analytical approach I took showed that smallholders are locked into a poverty trap, where socio-political relations and institutional rigidity prevent farmers from producing higher value commodities.

5. In Chapter 7, I revealed the links between dominant food discourses and environmental change adaptation. Consistent with Chapter 6, my data showed that Inopacan smallholders perceive different land management practices as suitable for achieving food and nutrition security. These different practices had varying levels of concern for adapting to environmental change. One land management practice was discussed by Inopacan smallholders with the language of 'cleaning the land' as a way of maximising available land for coconut production. In contrast, planting trees and agroforestry strategies were framed by the same smallholders as interventions to diversify incomes and build buffers to an increasingly unpredictable climate. Unless adequate institutional support is given to the alternatives, such as agroforestry, it will remain unclear as to whether alternate systems will enable farmers to improve their incomes, reduce risk and improve food security outcomes. I used Chapter 7 to show that smallholders in the case study have strong understanding of alternative pathways to improve food and nutrition security and adapt to environmental change. Institutions trapped in maladaptive behaviours, as identified in Chapter 4 (Davila, 2018), prevent new pathways and discourses from being developed. Chapter 7 showed that while alternative practices are perceived to be valuable to food and nutrition security, they continue to operate within a market food security discourse.
6. Throughout the thesis, I showed how human ecology provides a guiding theoretical framework for looking at the interactions between discourses and changes in institutions, human wellbeing, and ecosystems. I have advanced human ecology scholarship through integrating discussions of food discourse, largely taking place in the political sciences, into the broader realm of sustainability science. Through an

explicit focus on feedbacks between discourses and institutions, I have shown how human ecology offers food systems researchers an organised framework for analysing how systems behave under different discourses. This contributes to the range of soft systems methodologies geared towards understanding human–environmental processes through linking political discourse with system dynamics concepts.

7. Research grounded in the food systems domain needs to be prepared to be political, critiquing social relations and why systems behave the way they do. Food sovereignty discourse offers a powerful analytical discourse, as it explicitly focuses on how people interact with and influence food and nutrition security outcomes. This thesis used the underlying political concerns of the food sovereignty discourse to critique the nature of social relations and dominant policies in perpetuating food insecurity. The normative nature of sustainability studies and human ecology requires researchers to be willing to examine and critique how embedded institutions and rapidly changing environments perpetuate social inequalities, and the how these inequalities amplify environmental degradation. Such political critique in food systems allows us as researchers to understand why well-intentioned interventions fail and can guide us to identifying the root causes of maladaptive food system behaviour.

8.1.1 Limitations of this study

The boundaries for my analysis was set around systems concepts and food discourses scholarship. While this enabled for a nuanced discussion of the relationships between smallholder discourses and their agricultural and research institutions, there were valuable alternate lenses that could have added value to the research. The two major limitations upon finalising my analysis were the relative lack of discussion of gender roles and norms in the food discourses, and the links between human ecology and political ecology as fields of enquiry in rural landscapes. Gender transformative lenses in agricultural programs are increasingly recognised as fundamental in the design, conduct, and reporting of research outcomes (Lam *et al.*, 2019). Women in farming are estimated to contribute to 43% of global agricultural labour on the land, and are frequently required to engaged in unpaid labour to support their household's food consumption, schooling needs, and wider household maintenance (Doss *et al.*, 2017; Quisumbing *et al.*, 2014). Empirical studies in the topic of gender in agriculture consistently identify that women lack access to and control over resources, land, capital, and agricultural technologies, with much of this literature coming from Sub-Saharan Africa (Akter *et al.*, 2017; Quisumbing *et al.*, 2014). While women in Southeast Asian rural landscapes are generally more empowered than women in other parts of the world (Mason and Smith, 2003), the fact that they remain smallholders is likely to expose them to the similar inequalities and lack of agency identified in this thesis. Future research within similar fields of study to this thesis would benefit from understanding how norms, attitudes, and institutional systems in the Philippines have enabled or inhibited gender transformative rural opportunities. Given the findings in Chapter 4 of

the colonial legacies, and Chapter 6 and 7 findings of socio-political barriers, it is expected that gender transformations have been minimal in rural Philippines. Human ecology and the systems-based CAT can contribute to increasing the studies looking at the visible and invisible dimensions of gender transformations in rural landscapes.

Another limitation, largely conceptual and noting the challenges of drawing boundaries of interdisciplinary reviews, was the inclusion of political ecology scholarship throughout my thesis. Political ecology is, very broadly, concerned with understanding how environmental change is influenced by the political realities in which people live (Robbins, 2012). The origins of political ecology are rooted in agricultural issues, making them salient to the study of food discourses. Indeed, the seminal food regimes framework discussed in Chapter 1 and Chapter 6 is strongly rooted in political ecological thought (McMichael, 2009a). The inceptions of political ecology through the work of Blaikie and Brookfield (1987) suggests that environmental change occurs because of the local conditions of social and political structures in a particular place. Using the example of land degradation, the authors provided a launching platform for future analysis on environmental change which had a normative concern for environmental conservation, yet emphasised the role of politics and power in changing the immediate environments. Political ecology rapidly grew in the 1990s with further work from Blaikie and Bryant (Blaikie and Brookfield, 1987; Bryant, 1992; Bryant, 1998), and was furthered by many others concerned with the politics of environmental change (Forsyth, 2008; Peet *et al.*, 2011; Robbins, 2003; Robbins, 2012; Zimmerman and Bassett, 2003a). This all took place at the same time as La Via Campesina was building global momentum to articulate the political language of food sovereignty as an alternate discourse in food systems. A comprehensive review by Galt (2013) linked political ecology to food systems research, arguing that the shared collective action and political concerns of agroecology and the powerful role of non-state actors in food systems make political ecology relevant to field studies. In a theoretical triangulation study, Foran *et al.* (2014) argued that political ecology has a strong historical and ethical basis to contribute to the institutional and governance challenges in food systems. My thesis analysis could have been extended to include some of the nuanced land-use change drivers that have been influenced by the socio-political context of Philippines agriculture. Further analysis of my data could expand these political ecology studies to be linked to the systems-based aspects of the CAT, potentially addressing some of the limitations of the CAT as I will discuss in section 8.4.3 in this chapter.

The remainder of this chapter summarises my three major contributions: to Philippines studies, knowledge for transdisciplinary sustainable development, and knowledge for food systems research with increased use of social science methods and theories.

8.2 Contribution to knowledge for the Philippines

In this section, using the arguments and findings from Chapters 4, 6 and 7, I answer the research question initially presented in Chapter 1:

- What is the relational nature between discourses embedded among Filipino smallholder farmers' experiences of agriculture?

In Chapter 4, I showed how the Philippine macro-economic food system has been historically influenced by public policy and government institutions that have prioritised cash commodities as the main outcome of food systems (Davila, 2018). The Spanish colonisation process transformed Philippine landscapes, supporting extensive deforestation to meet increasing timber demands in global markets (Bankoff, 2007; Posa *et al.*, 2008). Within this system, legal institutions enabled elite families to acquire large quantities of land under a feudal system mirroring the land use system of Spain in the 1800s. This land ownership legal system meant that the growing number of local Philippine people became tenants of large land holdings and worked for others to meet their immediate household income needs. The end of Spanish colonisation and brief occupation by the United States of America continued timber exports and used cleared lands to develop a high-output agricultural system focused on tropical export cash crops, such as rice, sugar, coconuts, and bananas. This led to the creation of what is now the dominant macro-economic food system, where production is geared towards maximising the availability of cash crops which are envisioned to support farmers' incomes and supply the country with a domestic supply of basic food produce to meet domestic food security needs.

This historical and socio-economic analysis shows that the Philippines continues to follow a largely market-driven approach to food and nutrition security. As elaborated in this thesis, this market discourse traps farmers in food systems with feedbacks that amplify the deterioration of ecosystems, limits smallholders' ability to enhance their human wellbeing, and maintains maladaptive institutions. While the price of cash commodities increases with global prices, smallholders continue to face household food and nutrition challenges. Furthermore, the focus on cash commodities from the agriculture and forestry sectors in the Philippines has perpetuated social inequality, with elite families owning the land and smallholders thus being unable to be sovereign agents of their landscapes.

Public policies in Philippine food systems focus on income generation from commodity production. The income-centred approach to food and nutrition security continues to focus on financial access to food, but remains silent on accessibility, utilisation, and stability of food. This market-oriented framing of advancing food and nutrition security creates a positive feedback loop between institutional behaviour and market framings. Throughout the thesis, I emphasised the feedback process between Link 1 and Link 2 of the human ecology CAT (presented throughout the thesis, see Chapter 2 for overview), and explored the role of discourses influencing institutional behaviours (Figure 31). Linking systems thinking principles to qualitative analysis enabled me to demonstrate the influence of discourses on policies and on farm activities. The examples of timber and agricultural commodity-focused policies presented in Chapter 4 show how discourses can lock systems in maladaptive behaviours. The maladaptive reinforcing process summarised in Figure 31

continues to drive Philippine food interventions, and is unlikely to change unless the existing alternative discourses are acted on by a broader range of food actors.

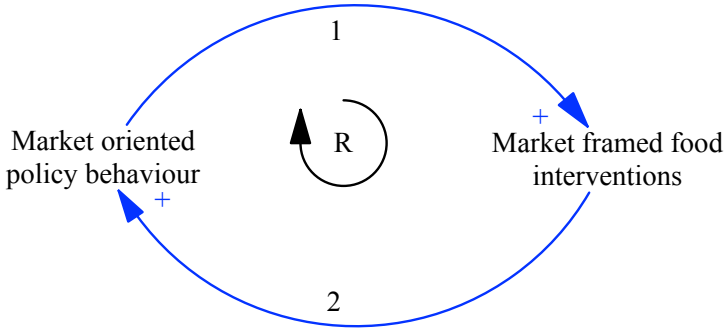


Figure 31: Maladaptive reinforcing feedback loop driven by market food security discourse. R indicates a reinforcing loop.

This dominant market framing of food security solutions is embedded among smallholder farmers, as I demonstrated in Chapter 6 and 7. My study has confirmed what the literature has thoroughly documented throughout the Philippines and in other developing country contexts: that smallholder farmers have consistently been framed as passive recipients of agricultural extension. The added value of my study has been in illuminating the underlying discourses that continue to frame smallholder farmers as passive absorbers of knowledge, rather than knowledge producers in food systems. I have shown that smallholder farmers have alternative food and nutrition security discourses that go beyond cash commodity production, and seek to work towards adapting to environmental change. Institutions, however, are constraining alternative knowledge and pathways from being implemented. Smallholders continue to operate within well-established parameters, where particular practices and social networks are supported at the cost of alternative ideas and marginalised communities. Historical cash commodity policies have sustained the exclusion of smallholder farmers as active decision makers on their landscapes. Institutions continue to support extension geared towards commodity production, and land entitlements that do not adequately allow farmers to be sovereign owners of their land (Borras, 2006; Borras, 2007; Lockie *et al.*, 2012). This ongoing discourse has inevitably filtered towards how smallholder farmers frame their food and nutrition security solutions and practices.

In the smallholder case study (Chapters 6 and 7), I showed how coconut farmers are trapped in a household-scale food system that prevents them from using commodities other than coconuts to meet their food and nutrition security. Rural households in the Philippines remain highly dependent on cash-commodity agriculture as their main source of income, and continue to face poor nutritional outcomes (UNDP, 2013; Zamora *et al.*, 2013). The market food security discourse embedded among smallholder farmers shows that they perceive cash income from coconut production as the driver of their improved wellbeing. However, my data analysis showed that coconut sales have been unable to deliver full food and nutrition security to farmers, with them frequently seeking greater incomes

for their household dietary and family needs. The ongoing localised support towards coconut extension services, and minimal opportunities for supporting farmers to diversify their income sources, generates a systemic trap for smallholders. Alternative visions of diversified incomes or production systems may eventuate if local government officers shift the framing away from providing knowledge, towards enabling the perspectives and knowledge held by farmers and findings ways of helping them act upon that knowledge. However, as discussed in Chapter 5, even extension officers and research agencies tasked with implementing interdisciplinary projects supporting food and nutrition security frame smallholders as inactive participants in their food system, perpetuating the ongoing reinforcement of existing systems.

The food sovereignty discourse is highly complex and has a number of propositions within it, but at its core it is concerned with critiquing the status quo of market driven food systems and improving the participation of individuals and communities in their food decisions (Jarosz, 1996; Patel, 2009; Wittman *et al.*, 2010). In an agricultural context, this translates to enabling smallholders to frame their production systems in line with what they believe is optimal to meet their food and nutrition security outcomes. The findings from this research show that if smallholders *were* to be sovereign decision-making agents in their system, they would have the opportunity to test the alternative production practices they perceive as pathways towards food and nutrition security. However, this sovereignty could lead to continuing 'land cleaning' practices, as they articulate this as a pathway for increased commodities and income. As presented in Chapter 6, this leads to a discourse that associates greater cash commodity productivity with greater food and nutrition security, largely due to the reliance on income. Smallholders' inability to experiment and test alternate production may jeopardise the biological diversity in the Philippines through continued landscape modification towards a single commodity. Furthermore, the continued reliance of coconuts as the sole source of income for farming families reduces their adaptive capacity to meet market or environmental shocks that may make their coconuts lose value. The evidence from the study shows that being a 'food sovereign' smallholder with full capacity to influence their land practice may not lead to the idealised improvements in human and environmental wellbeing often associated with the full principles of food sovereignty literature; notably the literatures focus on agroecological production as an alternate way of producing food. I expand on this limitation of food sovereignty as an alternate discourse later in this chapter (Section 8.4).

Smallholders demonstrated an understanding of alternative production practices that, if enabled through their sovereignty as decision makers, could lead to diversified incomes and improved environmental outcomes. The interview data reported on in Chapter 6 showed that farmers perceived the ability to diversify production towards other commodities, such as ginger and fruit trees, as a strategy that could improve their food and nutrition security. In Chapter 7, I further elaborated on these ideas by explaining smallholders' perceptions of agroforestry as a pathway for adapting to environmental change and diversifying incomes. In parallel to the coconut productivity solution, smallholders demonstrated an understanding of how different systems could benefit their immediate

human and ecological wellbeing. Farmers' ability to implement these systems, however, remain up to the local government agencies and capacity of farmers' organisations to advocate for training and support. The maladaptive natures of institutions, where power lies with those from with the right social networks and historical legacies remain prevalent in the structure and function of institutions, remain a barrier for local government units' ability to meet smallholders' alternative pathway discourses.

While agroforestry practices align with elements of food sovereignty, farmers continue to frame this alternative production systems within market systems. Using markets to increase incomes through diverse produce was found to be dependent on strong farmer-led organisations, or formal government agencies enabling new knowledge to emerge. The food sovereignty discourse, then, is embodied in these landscapes as increased diversity of produce and increased farmer ability to influence policy. In Chapter 7 I showed that smallholders are seeking greater 'sovereignty' to influence decisions on their lands – be it to increase coconut production, which there is policy support for, or to plant trees and high value crops, which receive lesser institutional attention. However, even if farmers were able to enact their sovereignty, they would still seek to achieve food and nutrition security outcomes through a market discourse; that is, through finding ways of selling their new produce through the current value chain. It is unclear if this diversification would break the historically embedded social relations where farmers remain passive agents in influencing their food systems, as explained in Chapter 3. Even the formal government institutions mandated to boost cash commodity production have attempted to embed intercropping and livestock into coconut production systems, with relatively positive knowledge and technology adoption rates. The findings from this study indicated that the markets, even though still framed as essential, are set to prioritise specific commodities over the smallholders' visions of agroforestry and high value commodities.

The nuanced perspectives and experiences of smallholder farmers discussed in Chapters 6 and 7 present researchers and institutions with evidence that different discourses exist in specific landscapes. In the Leyte context, agroforestry or coconut mono-cropping systems are both perceived as beneficial to human wellbeing. This benefit comes from using markets to improve access to food through purchasing power, enabling food security through incomes. The fact that smallholders articulate interest in using land management practices to adapt to environmental change *and* improve their profits show elements of the two discourses used as orienting concepts throughout this thesis. The shifts in literature, away from market food security and food sovereignty as conflicting, and towards a recognition that they are relational to each other (Carolan, 2014; Jarosz, 2014; Schiavoni, 2016), is supported by evidence from my research. I showed that the discourses are salient to the Philippines context, where smallholders are failing improve their income through established institutional structures. I further showed that there are potentially options for changing agricultural systems through enabling farmer organisations and alternate production systems that deliver to markets while also providing environmental adaptation strategies.

8.3 Contribution to knowledge for transdisciplinary sustainable development

In this section I expand the focus from the local landscape, and focus on regional interests in advancing food systems research for sustainable development. Using the findings from Chapter 5, I answer the question:

- What discourses exist among policy and research groups responsible for food and nutrition security activities?

In this thesis, I have advanced the understanding of transdisciplinary food systems research in Southeast Asia (Davila *et al.*, 2018). The region has had a traditional focus on food problems from a disciplinary and siloed approach, which has tended to prioritise agro-economic and quantitative analysis and interventions (Depositario and Saguiguit, 2014; SEARCA, 2014; Timmer, 2015). As defined in Chapter 5, transdisciplinary food systems research explicitly embraces diverging knowledge types, interests, and uses diverse methods to reveal new knowledge on how to achieve food and nutrition security (Francis *et al.*, 2008; Hammond and Dubé, 2012). Transdisciplinary research is driven by explicitly seeking to influence the outcome and behaviour of a system, and use knowledge from beyond academia to provide salience and legitimacy to the research process (Lang *et al.*, 2012; Mitchell *et al.*, 2015).

Throughout my PhD study, I have advanced transdisciplinary knowledge and practice by:

1. showing how systems methods enabled policy and research experts from four countries to reveal how they frame food and nutrition security interventions (Chapter 5),
2. conducting this PhD study as a Visiting Research Fellow at SEARCA, allowing me to collaborate in advancing SEARCA's visions towards systems-based food research and practice (Amparo *et al.*, 2017; Davila *et al.*, 2018),
3. demonstrating how the human ecology concepts used here offer a simple yet useful framework for enabling shared understanding of situations, in this case food systems. However, the framework is not without its limitations, notably in its inability to distil power relations and agency in systems.

In Chapter 5, I showed how a systems thinking activity conducted in a workshop setting revealed the dominant discourse presented by policy makers and researchers as remaining trapped in achieving system outcomes through market and cash commodity production. Research and policy makers directly linked food and nutrition security outcomes as dependent on productivity and the purchasing power of smallholders, along with sustaining the resource base from which commodities are produced. As discussed above, smallholders have clear ideas of possible pathways out of the current system behaviour, and they articulated needs for greater institutional support and increased farmer-organisational capacity. The workshop findings in Chapter 4 showed that smallholders' ideas remain unlikely to be enabled, as the notion of enabling farmer sovereignty through increasing participation and including farmers' perspectives remains largely marginalised. Challenging this

marginalisation requires different ways of doing research and generating policies for sustainable development that look for multi-sectorial and multi-knowledge synergies. To build these synergies, transdisciplinary research design and conduct offers an opportunity to connect knowledge systems and interests beyond academic understandings (Lang *et al.*, 2012).

Transdisciplinary research in food systems offers an opportunity for businesses, policy makers, farmers, consumers, researchers and wider food system actors to build new shared understandings of addressing food and nutrition security problems (Marin *et al.*, 2016; Rivera-Ferre *et al.*, 2013). Transdisciplinary food systems research is a growing field, especially in areas with high inequality and marginalised communities like Southeast Asia (Depositario and Saguiguit, 2014; SEARCA, 2014). Capturing how different stakeholders conceptualise food system interventions to improve food and nutrition security is critical for advancing systemic thinking in food problems. As a leading boundary organisation tasked with linking agricultural research with multiple actors, SEARCA is now working towards embedding transdisciplinary approaches into its research design (SEARCA, 2014). Since I conducted this study, notably the work with SEARCA in 2015 and 2016, two pilot projects from their inclusive rural development program have emerged. The first is in Mindoro Island in the Philippines, where an agricultural university and local government units are working to revitalise the Calamansi industry as a high value crop for smallholders. In Leyte, the Inopacan local government unit and Visayas State University are seeking to increase smallholders' capacity to produce high value commodities, notably jackfruit, banana, and tilapia fish. While these projects have reported active participation from smallholders, and are meeting with some success in either diversifying production systems or enabling new markets opportunities, their current approach does not guarantee a permanent discourse shift or scale-up of activities. This is largely because the projects are short term and are dependent on external knowledge and resources to generate alternate production systems, reducing farmers' autonomy and ownership of the changes.

In Chapter 5, I showed how policy and research experts from Cambodia, Laos, Thailand, and The Philippines have a dominant discourse that does not align with the sustainability principles of transdisciplinary research. The limitations of these discourses have implications for the regional endeavours of organisations like SEARCA and their ability to enable sustainability-oriented discourses to become mainstream in food systems research and policy. Through using workshop activities and applying the human ecology framework, I showed that policy and research efforts continue to focus on technological extension to increase productivity as the core driver of food and nutrition security. The perspectives articulated in this workshop align with the interview findings from Chapter 6 and 7. The results from the systems mapping during the workshop indicates that there is ongoing framing of smallholders as actors who will follow development pathways set by research and institutions, and not be active participants in these processes.

This understanding creates barriers for genuine transdisciplinary research. At its core, transdisciplinary research is concerned with the co-production of knowledge between different stakeholders during the full research process. Smallholder farmers continue to be marginalised from

roles as active agents of change in their food systems, and this perception of farmers as passive knowledge-absorbers was confirmed by Chapters 5, 6, and 7 in this thesis. Ongoing policy support for large scale landscape changes in Southeast Asia mean that smallholders continue to be powerless in landscapes (Dressler *et al.*, 2016b; McCarthy and Obidzinski, 2017). Transdisciplinary endeavours seek to address these power inequalities through trying to embed farmers in research and policy processes. However, as my analysis showed in Chapters 6 and 7, smallholders hold dual understandings of possible solutions to food and nutrition challenges. The analysis of smallholder interventions showed that while they seek to diversify and develop climate adaptation strategies, they still hold dominant discourses that align with maladaptive policy support for cash commodity production practices cemented through historical institutions. It remains unclear whether transdisciplinary approaches will genuinely allow for a transformation in discourse, or whether they will act as an avenue to improve stakeholder collaboration that only perpetuates existing dominant discourses on how to achieve food and nutrition security. The human ecology framework presented here can be used to stock-take how transdisciplinary regional activities are rolled out, and to analytically explore the extent to which interventions enable envisioned alternative discourses, or just amplify the current strength of cash- and income-driven discourses.

This study has revealed that perceived solutions to food and nutrition security align with dominant market food security discourses, as shown in Chapters 5-7. While it is critical to enable markets to benefit marginalised communities, a major challenge remains in failing to critique dominant discourses and identifying meaningful intervention. Power dynamics, inequality, and lack of agency remain a critical development challenge in smallholder farming contexts (Cramb *et al.*, 2016; McCarthy and Obidzinski, 2017). Traditional market discourses fail to acknowledge these power inequalities, and global institutional discourses continue to support globalised commodity driven food systems that affect human and environmental wellbeing (Clapp, 2015; Dyball, 2015; Lee, 2013). There continues to be rapid modification of landscapes, and growing urban consumption continues to influence the dominance of the market security discourse (Dressler *et al.*, 2016b; McCarthy and Obidzinski, 2017).

This thesis showed how qualitative research that draws from extensive critical social science theories and analytical approaches can look at how specific activities, such as agriculture, operate within broader social and environmental processes and food activities. This is now established as a necessary step towards advancing food systems understandings beyond traditional disciplinary and technical approaches focused on agro-economics, farm productivity, and metric-driven food security research (Garnett, 2016; Horton *et al.*, 2017; Ingram, 2017; Ingram *et al.*, 2016). This thesis has looked at the policy and institutional dimensions of decision making, and how smallholder farmers would need to enact alternate food sovereignty principles to create different food systems to improve their immediate human wellbeing and ecosystems. The agroforestry and high value products that smallholders wish to develop will require urban consumers to demand those products, and increased farmer access to merchants and processing facilities, to enable farmers to meet the growing demand.

Building a critical understanding among consumers of the inequalities and environmental context in which food is produced can act as another leverage point to increase farmers' ability to diversify their income and production systems (Davila and Dyball, 2015; Dyball, 2015; Porter *et al.*, 2014).

Throughout the design, conduct, and dissemination of this study I have worked with a number of non-academic food system actors to advance food systems research. I grounded my work on current approaches being taken by SEARCA to pilot and test transdisciplinary food systems research in Southeast Asia. My field work, documented in Chapters 6 and 7, allowed me to visit Inopacan twice to establish links with the municipal office, agricultural extension officers, and smallholder farmers. The research articles I have written have provided evidence of the critical need to expand the inclusion of smallholder-perceived pathways into the agricultural research and projects that get rolled out in the Philippines in the future. This is relevant to Philippine institutions, but also to the funders of agriculture in developed countries. Beyond research, the networks established across the Australian National University, the University of the Philippines Los Baños, and SEARCA have started to create a knowledge system concerned with advancing transdisciplinary research and teaching in Southeast Asia.

8.4 Contribution to knowledge in food systems and human ecology

This section focuses on contributions to food systems scholarship, and to human ecology. I answer the sub-questions:

- How does human ecology help guide analysis of food system discourses?, and
- How do these theoretical and empirical findings contribute to advancing food systems and human ecology scholarship?

8.4.1 Contributions to food systems and food discourse research

In Chapters 2 and 3, I presented human ecology as a methodological approach for understanding the influence of discourses on human wellbeing, ecosystem change, and institutional behaviours. In Chapter 3, I proposed human ecology as a framework suitable for advancing post-normal enquiry. Such enquiry requires the analysis of sustainability problems where facts, knowledge, and values are contested, yet urgent interventions are required to improve the state of systems (Colloff *et al.*, 2017; Funtowicz and Ravetz, 1993; Ravetz, 2006a). Human ecology, as presented and applied in food systems literature in Chapters 3 and 4, prioritises human–environment interactions primarily as the feedback processes that influence the behaviour of a system. I embedded political food discourse ideas into human ecology, and situated this within the food systems research domain. Such political analysis allowed me to blend qualitative discourse explorations with systems principles within a sustainable development context.

Throughout the thesis, I focused on the feedback processes between food discourses and institutional response as critical for identifying system interventions in food systems to improve human and ecosystem wellbeing. The human ecology framework I used enabled me to capture the underlying essence of a complex problem; in this case, persistent hunger and smallholder poverty in a developing country context. By understanding feedbacks between core variables, human ecological thinking enables researchers and policy makers to embrace the overwhelming complexity of wicked problems in a systematic way (Dyball and Newell, 2015; Newell and Proust, 2018; Newell and Siri, 2016). As stated in Chapter 3, this systemic thinking is 'important for decision making, as one cannot understand the behaviour of such systems by studying the behaviour of the parts taken in isolation' (Davila and Dyball, 2018). However, to have practical implications, building this understanding needs to be done without overwhelming analytical processes with complexity (Newell and Siri, 2016). The framework applied conceptually and analytically in this thesis enabled the study of a wicked problem through showing how different discourses are embedded in food systems literature (Chapter 3), and more broadly, in food system activities in Southeast Asia and the Philippines (Chapters 4, 5, 6, and 7).

Figure 32 summarises the links drawn throughout this thesis using literature and empirical material. I leveraged from the first orienting concept from Chapter 1 (food systems as a research domain) to progress the use of social sciences and advance food systems research. This thesis has contributed to the inclusion of critical social science theories and approaches to the growing interest in conducting socio-political enquiry into food systems. Other studies have identified a growth in governance research in food systems (Hospes and Brons, 2016), and how the narratives of sustainable food systems influence how to research and identify solutions (Béné *et al.*, 2019). The political nature of food systems is also now critically examined beyond academia, with international panels and philanthropic bodies calling for deeper connection with the politics of food (IPES Food, 2015; IPES Food, 2017). The combination of theoretical and empirical research in this thesis shows that human ecology is positioned to continue these conversations within the academic and practitioner realms of food systems. The material presented in this thesis can be taken forward as a growing body of researchers and professionals trained in food systems thinking can critically identify the underlying discourses and their relationships to institutionally-embedded rules and norms. This can help identify the perceived different points of interventions among different stakeholder groups, and work towards creating shared understandings of how to implement such interventions.

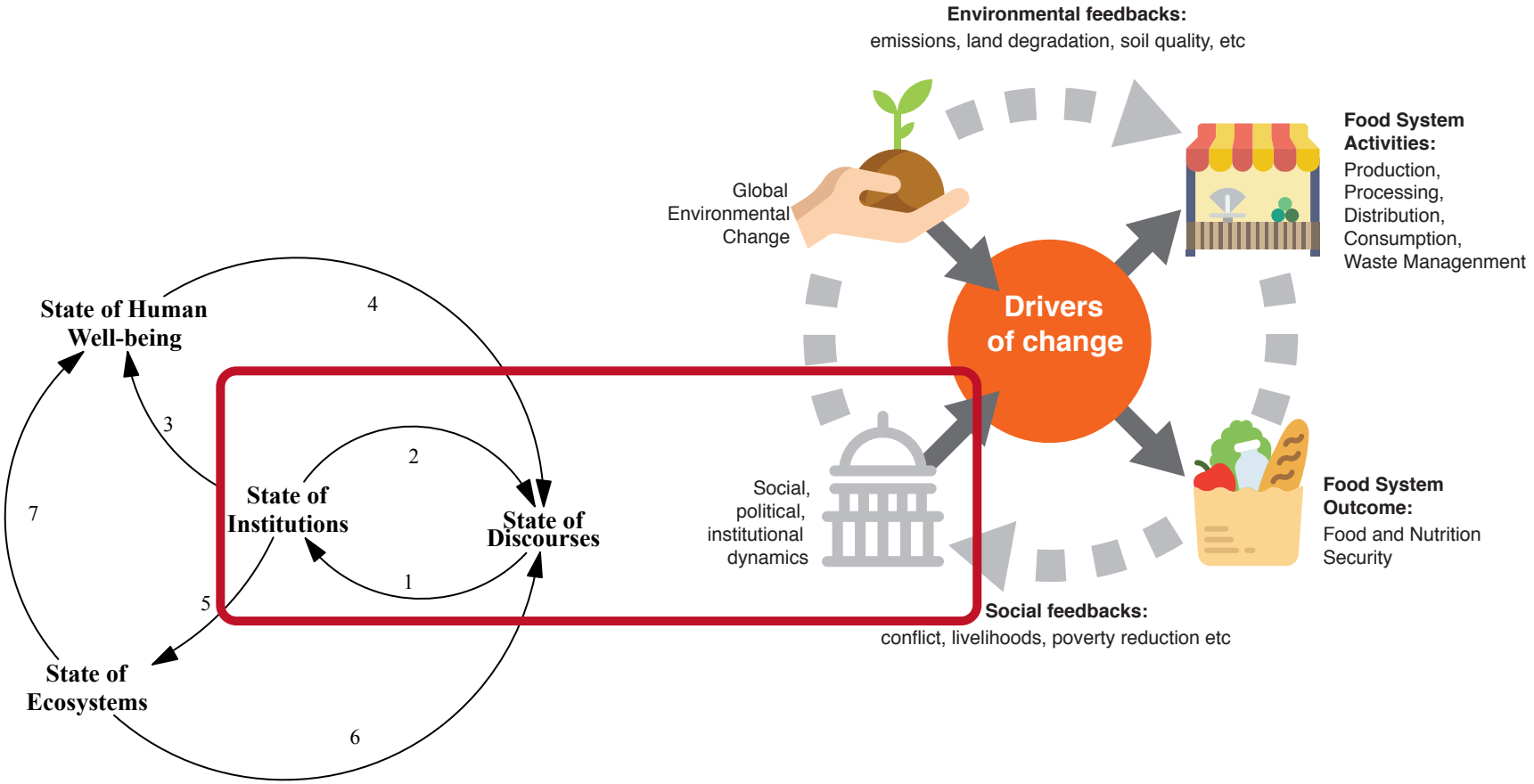


Figure 32: The red box shows the conceptual contribution towards linking discourses, institutions, and human ecological analysis in food systems

The literature analysis in Chapters 3 and 4 allowed me to map two abstract discourses, food security and food sovereignty, and how they apply to major issues in food institutions, ecosystems, and human wellbeing (Davila and Dyball, 2018). I conducted a similar analysis in a historical context, and explored how the dominant discourse of cash commodity production has created an inequitable and environmentally unsound food system in the Philippines (Davila, 2018). Through using a coherent framework throughout the thesis, I showed how a human ecology perspective enables analytical research that conceptually tracks the influence of discourses in food systems. The framework also allowed me to look at different scales in food systems, with Chapter 3 focusing on more globalised ideas and trends, and Chapter 4 focusing on national Philippine issues. In Chapter 5 I used the framework to identify how leading research and policy stakeholders conceptualise smallholder participation in their food system, revealing barriers for transdisciplinary food systems research in the region. Finally, in Chapters 6 and 7, I showed how human ecology can be used to reveal smallholders' framings of food and nutrition security interventions and behaviours. This multi-scale transferability of the framework advances our understanding of the links between political discourses and food systems research agendas, as it can contextualise abstract theoretical ideas within a coherent set of variables. Although a general boundary was drawn to food producing systems, the inevitable links with biodiversity conservation, climate change, and market behaviour enabled me to explore how the discourses apply to different drivers and activities in the food system.

Human ecology's explicit systems framing helps scholars look at all elements of the food system. The systemic foundations of human ecology have been documented in the historical developments of the field, both pedagogically and methodologically (Boyden, 1992; Boyden, 2016). Human ecological scholarship has varied between disciplines: some scholars aligning it more with anthropology and social ecology (see Stokols, 2018), some with deeper philosophical enquiry into the normative relationship between humans and their environment (see Polk and Bruckmeier, 2005), while others have taken an integrative systems dynamic approach (for example Dyball and Newell, 2015). Despite this divergence, one common thread remains throughout the branches of human ecology: an explicit concern for critical enquiry into how systems *ought* to operate to deliver just and sustainable futures.

This thesis focused on agricultural institutions and their role in influencing smallholder behaviour in the Philippines, and used human ecology as a framework. Similar discourse analysis, however, is salient to the wider food system. For example, consumer behaviour remains a major driver of food waste and unhealthy diets globally, and an institutional discourse analysis would offer insights into what creates such behaviour. Managing global environmental change is also influenced by private or public institutions' framing of what the problem is and what interventions to make. For example, technological advancements continue to frame interventions into a changing climate, notably through practices such as climate-smart agriculture. The extent to which climate-smart technologies are salient to smallholder needs and relevant to the gender, cultural, and institutional

dynamics that exist in farming contexts can only be determined through social enquiry. Using social theories, such as discourse, within a sustainability-oriented framework, such as human ecology, can support the design of technological and institutional responses to food challenges.

Food security and food sovereignty discourses have cemented themselves in the literature as enabling different food system activities and outcomes. The explicit concerns over human rights, social justice, and agroecological production places food sovereignty within sustainability frameworks that seek to achieve human and environmental wellbeing. Market food security lags in enabling critical discussion of how established food activities and socio-political institutions perpetuate compromised social relations and inequality. As Roman-Alcalá (2016) states, sovereignty is the product of the context and relationships that exist at one point in time; it is not an end outcome. In contrast, food and nutrition security is a measurable outcome, locked into achieving a 'situation' at one point in time that delivers access to safe and nutritious food. Meeting this outcome, measurable through extensive metrics provided by economic and nutritional studies, requires *processes* of decision making, which the food sovereignty discourse reveals. Such processes, however, will only enable genuine smallholder participation as long as the institutional structures and enabling environment allows smallholders to advocate and implement their perceived solutions.

Food sovereignty discourse, which was explored in this thesis through looking at social relations and alternative agricultural practices, was found to be present in two ways. One was through the explicit acknowledgement by smallholders of the role that social relations play in supporting agricultural interventions, presented in Chapter 6. The second was through smallholders' perceptions of the role that production diversification towards agroforestry or high value commodities plays in diversifying incomes, as presented in Chapter 7. A critical aspect of the case study in Chapters 6 and 7 was the dominant perception among smallholders in Inopacan that they must maintain the current system behaviour of 'cleaning the land' and relying on coconuts for income. The assumption in food sovereignty literature is that if smallholders and communities are democratically enabled to influence their food systems, systems will be more social just and sustainable. What would happen in Inopacan, then, if farmers were enabled to enact their perceptions of land management? Given the discourses they hold on continuing to work within coconut mono-crop systems, it is unlikely that this will enable reconfiguring social relations, creating resilience capacity to climate change, and improving local natural resources and biodiversity habitat. This then presents a challenge to food sovereignty advocates: will they be willing to accept that building sovereignty among smallholder may not lead to the environmental and social inclusion outcomes assumed by the food sovereignty discourse? Sovereignty as a relational process between immediate social and environmental contexts is thus a critical element of future analysis of how increasing participation in food systems can genuinely deliver improvements to human and ecological variables in those systems. Other studies in Southeast Asia and Latin America have documented experiences where collective action and institutional structures have enabled smallholders to be 'sovereign' agents of their food production systems. However, these studies have found that while decision

making and power are high in communities, and some even employ agroecological practices, communities continuously choose to form part of the neoliberal market structures and systems that the food sovereignty discourse openly critiques (Li, 2014; Soper, 2019).

Throughout this thesis, I have reported on food activities, particularly agriculture, as influenced by the specific context in which discourses exist. This confirms the value of relational ontology as the foundations of the approach I have taken, enabling me to study the discourses and how they relate to the environmental, social, and economic contexts in which they exist. In my thesis, I have documented how the framings of improving human and environmental wellbeing have been shaped by hist0orical institutional legacies and the developmental needs of the Philippines. The use of political science literature in food systems teaching, research, and practice adds a layer of critical awareness of how and why we interpret food interventions in a particular way. Food scholars would benefit from embedding both the quantitative and qualitative advances in food research and practice to present a genuinely systemic view of how food challenges can be addressed. While metrics can provide options and baselines, they cannot provide us with the tools for analysing why human systems behave as they do. The critical social sciences do this, and human ecology offers a framework for understanding how such social systems react to the changes in ecosystems, human wellbeing, and institutional behaviour.

The inclusion of discourse literature and qualitative methods into the food systems research domain has enabled me to advance the field in an interdisciplinary way. I have linked political concepts of food discourses (food security and food sovereignty) to sustainability science concepts (transdisciplinarity) in food systems. The ability to describe, analyse, and predict food system states and futures requires ongoing use of both scientific enquiry and critical social science concepts (Godfray *et al.*, 2010). As stated in Chapter 3, aligning with post-normal science, human ecology is overtly normative in that it seeks to reflect critically on problem situations, precisely to change them into better situations, both socially and environmentally. Through connecting the fields of human ecology, food systems, and food discourses, my study has shown how stakeholders across specific food activities frame interventions to improve the state of the system according to their dominant discourse. Identifying these perceived interventions now enables future food systems research in these contexts to critique the extent to which such perceived interventions would be environmentally and socially sound. The growing interest in Southeast Asia in developing transdisciplinary approaches to food research creates an opportunity for the findings of this study to inform future participatory and co-production-oriented research in the region.

8.4.2 Contributions to human ecology

As a social researcher, I have been reflexive throughout the research process in acknowledging the limitations that frameworks place on how we ask questions, interpret theories and data, and situate our results into broader literature and policy developments. My study was influenced by my training in interdisciplinary sustainability science and practice in the international development

research and professional services community. Human ecology offered me an opportunity to integrate my experiences of working in the international agricultural research field with food systems and political discourse literature. In this section, I highlight how I have progressed the empirical application of human ecology as a sustainability science framework.

The work of Dyball and Newell (2015) presents a comprehensive human ecological approach to sustainability, informed by systems dynamics principles and retaining a focus on linking human and environmental behaviours in specific systems. This thesis has taken human ecology as a framework for understanding human and environmental feedbacks, and tested it using empirical data from workshops and semi-structured interviews. I sought to discover how such systems framework can be blended with qualitative research and integrated with political science literature to discover why and how systems operate at a particular point in time. Chapters 6 and 7 enabled me to apply human ecology analytically to qualitative data. Following coding methods from qualitative research, I used the systems principles of human ecology to reveal how smallholders frame the food systems around the institutional, social, and environmental dimensions of advancing their food and nutrition security. I have also included political and power relation discussions into human ecology, notably through drawing from the extensive literature on food security as a market discourse and food sovereignty as a participatory and sustainability-oriented process to improve human and environmental wellbeing. While the CAT used throughout this thesis provides a way of capturing the behaviour of a system at one point in time, it remains limited in the sense that it fails to explicitly integrate issues of inequality and power within the system. The inclusion of human discourses into the template allows us to look at how critical social science literature, such as that found in food sovereignty scholarship, can be used to examine how and why systems behave in a particular way. Human ecology offered me an opportunity to link my experiences in international development research and practice, and explore food discourses in both a theoretical and applied sense. In doing so, I discovered opportunities for using human ecology for future food systems enquiry.

Human ecology provides researchers and practitioners with a coherent framework for understanding the relationships between individuals and groups in light of escalating environmental change. Human ecology's development in response to increasing environmental crises in the 1970s enabled a range of disciplines to advance the study of human-environment interactions (Stokols, 2018). In Chapter 1, I contextualised this study within the Anthropocene and the increasing concern over humanity's ability to live within a 'safe operating space' and planetary boundaries. It seems that the last decade's progress in embedding concepts of planetary limits into sustainability scholarship offer an opportunity for new human ecological research, teaching and practices. In this thesis, I have provided an example of how we can use human ecology as a methodology to advance progress in improving agricultural systems, in light of rapid food systems change.

8.4.3 Limitations of the Cultural Adaptation Template

The conceptual foundations of this thesis were grounded at the nexus of the field of human ecology and the theoretical debates of food discourses. Throughout the thesis, I have connected the fields through using the CAT as a heuristic tool to understand how discourses exist in different scales, both empirically and in the literature. While a useful framework and an organising tool for the field of human ecology, it is not without its limitations. The proponents of the CAT acknowledged the 'desire' of communities to shift within alternate discourses, and note the tensions of communities being 'inspired to adopt the new activities' (Dyball and Newell, 2015 p. 201) in order for alternative discourses to gain traction. They continue to argue that gradual steps of 'alternative' ways of operating within existing dominant discourse may slowly create the behavioural changes needed to enable new discourses. While this may be the case in these systems, my study has demonstrated that even when alternative discourses exist in rural landscapes, such as agroforestry systems identified in Chapter 7, the deeply embedded historical power legacies will prevent genuine alternative discourses from eventuating. This presents a conceptual opportunity for human ecology, as presented in this thesis, to more critically embed issues of power and politics into its analysis of sustainability problems. Throughout my analysis and integration of agrarian literature on smallholder development, food security, and food sovereignty, I have identified how historical legacies (Chapter 4), institutional framings of smallholders (Chapter 5), and local social relations (Chapters 6 and 7) perpetuate power structures and current ability for smallholders to have greater agency in their systems. These thus allows me to critique two elements of the CAT which present opportunities for further research.

One is the relatively dormant role of political enquiry in the CAT. I would contend that this challenge is not exclusive to this framework alone, but also prevalent across other systems methodologies. As outlined in sections 2.4 and 2.5 of this thesis, systems methodologies have a long history of adapting to the critiques of reductionist and mechanistic thinking in engineering systems. With the growth of soft systems methodologies, new heuristic frameworks were developed to understand how different behaviours, worldviews, and feedbacks formed part of people's way of thinking and the relationships between humans and their environments (Checkland and Scholes, 1999; Ison and Russell, 2000; Meadows, 2008). Political enquiry, however, remained largely absent from this development in soft systems thinking which constrained itself to the fields of management, pedagogy, and agroecosystems. As the soft systems theories grew in the 1980s, so did the critical agrarian scholarship of understanding the structural inequalities of increasing globalised food systems and value chains (Friedmann and McMichael, 1989). This scholarship presented arguments for how social inequalities embedded in agricultural extension programs, the corporatisation of food systems, and the neoliberal policies that reduce farmers' agency and power gets allocated to corporations and global institutions. While this thesis was constrained to food and agriculture literature, similar political discussions can be found in issues of biodiversity conservation, climate change, and international development – all critical fields in current sustainability research. Given

the ever-increasing importance of politics and power in sustainability, the CAT framework requires further analysis and integration with the political sciences to embed potentially new variables and feedbacks that distil the power and agency dimensions of the sustainability problem being analysed.

Advancing political enquiry within the CAT framework relates to the second conceptual limitation I found throughout this thesis: the limiting nature of four variables. While the variables proposed by Dyball and Newell (2015) build strongly from the systems steps identified by Meadows (2008), and are articulated as being relevant to *any* sustainability challenge, they do present analytical boundaries which prevent people applying the framework to empirical data by drawing in emerging findings. As noted in Chapter 2, the value of adaptive research approaches as per Layder (1998) allow for researchers to guide their research with particular frameworks but also to enable new ideas to emerge from the data. In implementing this throughout my thematic coding of interviews as per the CAT framework, I found that the analysis was always going inevitably limit itself to variables of ecosystems, institutions, human wellbeing, and discourses. A question remains of where, for example, the CAT would allow issues of how gender relations influence the state of community or institutions, or how issues of off-farm labour or rural-urban migration influence the state of a particular discourse. These issues are critical in rural Philippines, and the application of a wider set of variables would have presented additional findings and issues relating to food and nutrition security in the Philippines.

Despite these conceptual limitations, the political scholarship in food systems creates avenues for future research and theoretical development of the CAT. This thesis allowed me an opportunity to conduct interdisciplinary analysis in which I was able to draw from agrarian change and food discourses scholarship, sustainability science, and human ecology to tell a story of smallholder marginalisation and food discourse co-existence in the Philippines. Through applying the CAT systematically to my coding structure of qualitative data and literature material, I found that, without complementing the CAT with the food literature, I would have missed some of the tensions in social structures and power relations that prevent smallholder farmers from being agents of change in their food systems. Future research applying the CAT would benefit from exploring different parts of the food system, such as consumers' sovereignty and agency, and to add more comprehensive applications of the framework to other food system activities beyond agriculture.

Throughout this study, the CAT has provided a useful heuristic device for connecting different disciplines in rural food studies and sustainability science with empirically collected qualitative data. The systems analysis and organisation of the data into set variables through the research process can help reveal the underlying discourses held by individuals and groups, and the role of these discourses in maintaining systemic relationships. This mapping of discourses is useful where multiple actors expected to form part of growing transdisciplinary research where co-design, conduct, and assessment of research outcomes on sustainability problems is expected (Lang *et al.*, 2012). A future step for human ecologists applying the CAT in research design and practice is to give greater

consideration to which power and political dimensions of sustainability influence the four major variables in the CAT.

The human ecology approach as undertaken in this thesis can be used by stakeholders interested in mapping the different possible system behaviours of sustainability and social challenges they are facing. For government officials, human ecological frameworks offer a way of understanding how and why policies exist and their influence in various system variables. For researchers from specific disciplines, the framework offers a way of populating variables with technical disciplinary knowledge, and offers a 'shared language' for working with other disciplines. For the growing body of early career researchers developing skills for inter- and transdisciplinary research (Haider *et al.*, 2017), the framework allows a coherent structure for organising the often conceptually complex challenges in sustainability. Community and corporate actors can use human ecology in workshops, reporting, and general practice to think about how their individual discourses and agendas influence broader aspects of the system they are part of, offering a chance to reveal unexpected system behaviours (Newell and Proust, 2018; Newell and Siri, 2016). Such organisational and conceptual tools are essential to advance sustainability initiatives that address the root causes of problems (Abson *et al.*, 2017; Fischer *et al.*, 2012).

8.5 Conclusions

To conclude the thesis, I use my analysis to look forward into the growing field of food and nutrition security research within the food systems domain. I ask:

How do the policy, research, and smallholder discourses inform the future analysis of social drivers in food systems research?

The first orienting concept of this thesis framed food systems as major research domain in food scholarship. This systems framing of food research is increasingly used by academic and policy agencies interested in solving food challenges (Horton *et al.*, 2017; IPES Food, 2015; Lindgren *et al.*, 2018). Global visionary multi-stakeholder platforms like the International Panel of Experts in Food Systems (IPES Food, 2015) have documented experiences from academia, policy, business, and public actors to comment on how food systems framings can enable pathways to sustainable futures. Systems approaches are critical for understanding how producers, distributors, consumers, policy makers, and non-government actors influence a system undergoing the affects of changing social and environmental contexts. In my study, I focused largely on smallholder agricultural production, as it remains a major driver of human development and environmental degradation globally (Springmann *et al.*, 2018; World Bank, 2008). This focus on smallholder production in farms under 2 hectares, which continue to provide 35% of total food output, (Ricciardi *et al.*, 2018), was situated in this thesis within a broader food systems context. This meant that, while I analysed in detail the discourses at a smallholder village level, I linked the analysis to a wider application to food discourses that encompass the different components of food systems. To conclude my thesis, I

discuss how the tensions between food security and food sovereignty offer opportunities for future food systems that are transdisciplinary in nature and embrace the post-normal nature of sustainability problems.

Transdisciplinary research requires open reflection on the underlying values, beliefs, assumptions, and discourses held by the groups involved in research (Lang *et al.*, 2012; Lang *et al.*, 2017). The human ecology framework applied in this thesis brings value to transdisciplinary enquiry by allowing stakeholders to capture how they conceptualise the nature of the problem and perceived solutions. Applying the framework into participatory systems-based activities, as done in Chapter 5, or into an analytical tool for qualitative data, as done in Chapters 6 and 7, will be of value to future food systems researchers. The human ecology framework enables explicit focus on feedbacks between major variables in a food system. Through enabling individuals or groups to go through a thought process of synthesising key variables, the framework helps us deal with the complexity of a problem. The transferability of the framework between scales, from household (Chapters 6 and 7) to national (Chapter 4) allows researchers to look at how variables behave in different contexts and in response to different discourses.

This study advanced the qualitative understanding of the systemic nature of food discourses' influence on institutional behaviours, with a focus on the Philippines and a Southeast Asian regional boundary organisation. Future analysis into how these discourses influence quantifiable changes in food systems, such as the nutritional status of a population or changes in land use, is necessary. For example, studies into how coconut policies can enable options for nutritional diversity, or studies into the impact on incomes of intercropping systems in Leyte, would advance quantitative knowledge of these agroecosystems. This use of both quantitative and qualitative approaches would enable the human ecology framework application to comprehensively link the social sciences with the biophysical and economic studies, revealing the power of human ecology as a transdisciplinary field. This can help us reveal the social and biophysical interventions required to improve food system behaviours.

Policies that look beyond specific problems towards systemic links between sectors are highly complex, as they require negotiations between different jurisdictions and sectorial departments, and are likely to involve multiple political interests. The examples from the Philippines show that policies have not been systemic, rather they have focused on trade and agricultural output at the cost of environmental and nutritional wellbeing. Whilst specific interventions in a fragmented way can remediate the immediacy of some problems, such as targeted nutritional programs, longer term change will require systemic design. The framework developed throughout this thesis can continue to be used to capture how competing stakeholder groups understand problems and find ways of building shared understandings of interventions. This can be useful for the initial stages of policy and strategy design that seek to be systemic in nature. Using the framework to build shared understandings can enable competing interest groups to identify common threads, and use those threads as levers to generate ideas that envision improved futures.

In a world that will have nine billion people by 2050, with rapid environmental change and growing inequality, research oriented at targeting the underlying drivers of problems is essential. Systems thinking and human ecology offer frameworks that can conceptually guide analysis into the feedbacks between our discourses and system variables. The conceptual analysis also offers practical tools to facilitate knowledge exchange and analytical strategies for identifying underlying discourses that influence a system's behaviour. As the largest contributors of greenhouse gas emissions, and affecting all of the world's people, food activities present a wealth of opportunities for addressing sustainability problems. The emergence of food systems as a conceptual platform to address food-related challenges has enabled a growth in understanding the biophysical and social interactions that influence the sustainability of food activities. In this thesis I have advanced the study of food discourses within the food systems framework, documenting the analysis using a mix of literature, historical analysis, workshop facilitation, and semi-structured interviews. With this thesis, I have progressed our interdisciplinary understanding of the social and institutional drivers of food systems through linking human ecology, food discourses, and food systems literature. The theory and case study analysis documents how such an interdisciplinary approach can guide our identification of intervention points to improve sustainability research and policy in food systems. The material presented in the thesis advances our body of knowledge in food systems research, offering a human ecological approach for improving our understanding of food discourses in a smallholder development context.

Chapter 9: References Cited

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C. D., Jager, N. W. and Lang, D. J., 2017. Leverage points for sustainability transformation, *Ambio,* **46**(1): 30-39. Available at: 10.1007/s13280-016-0800-y

Adam, J., 2013. Land reform, dispossession and new elites: a case study on coconut plantations in Davao Oriental, Philippines, *Asia Pacific Viewpoint,* **54**(2): 232-245.

Adler, C., Hirsch Hadorn, G., Breu, T., Wiesmann, U. and Pohl, C., 2018. Conceptualizing the transfer of knowledge across cases in transdisciplinary research, *Sustainability Science,* **13**(1): 179-190. Available at: 10.1007/s11625-017-0444-2

Aerni, P., 2011. Food sovereignty and its discontents, *African Technology Develoment Forum,* **8**(1): 23-40.

Akram-Lodhi, A. H., 2009. Modernising subordination? A South Asian perspective on the World Development Report 2008: Agriculture for Development, *The Journal of Peasant Studies,* **36**(3): 611-619. Available at: 10.1080/03066150903142972 (accessed 2015/01/11).

Akram-Lodhi, A. H., 2015. Accelerating towards food sovereignty, *Third World Quarterly,* **36**(3): 563-583. Available at: 10.1080/01436597.2015.1002989

Akram-Lodhi, A. H. and Kay, C. (eds), 2009. *Peasants and Globalization: political economy, rural transformations and the agrarian question,* Routledge, New York, (original work

Akter, S., Rutsaert, P., Luis, J., Htwe, N. M., San, S. S., Raharjo, B. and Pustika, A., 2017. Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia, *Food Policy,* **69**: 270-279. Available at: https://doi.org/10.1016/j.foodpol.2017.05.003

Alders, R. and Kock, R., 2017. What's food and nutrition security got to do with wildlife conservation?, *Australian Zoologist,* **39**(1): 120-126. Available at: https://doi.org/10.7882/AZ.2016.040

Alexandratos, N. and Bruinsma, J., 2012. *World agriculture towards 2030/2050: the 2012 revision*, Food and Agriculture Organization, Rome.

Altieri, M., 1995. *Agroecology: The Science of Sustainable Agriculture*, Westview Press,

Altieri, M. and Nicholls, C. I., 2008. Scaling up Agroecological Approaches for Food Sovereignty in Latin America, *Development,* **51**(4): 472-480.

Altieri, M. A., 2009. Agroecology, Small Farms and Food Sovereignty, *Monthly Review,* **61**(3): 102-113.

Altieri, M. A. and Toledo, V. M., 2011. The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants, *Journal of Peasant Studies,* **38**(8): 587-612. Available at: https://doi.org/10.1080/03066150.2011.582947

Amparo, J., Davila, F., Dyball, R., Geges, D. B., Jimena, C. E. G., Malenab, C. T., Mendoza, E. T. and Saguiguit, S. L., 2017. *An analysis of smallholder commodity systems using and integrative and systems based framework in two pilot ISARD sites in the Philippines. SEARCA SFRT Final Report.* , Los Banos, the Philippines.

Anderson, M. and Bellows, A., 2012. Introduction to symposium on food sovereignty: expanding the analysis and application, *Agriculture and Human Values,* **29**(2): 177-184. Available at: 10.1007/s10460-012-9369-7

Anderson, M. D., 2008. Rights-based food systems and the goals of food systems reform, *Agriculture and Human Values,* **25**(4): 593-608. Available at: 10.1007/s10460-008-9151-z

Bacon, C. M., 2015. Food sovereignty, food security and fair trade: the case of an influential Nicaraguan smallholder cooperative, *Third World Quarterly,* **36**(3): 469-488. Available at: 10.1080/01436597.2015.1002991

Bacon, C. M., Sundstrom, W. A., Flores Gómez, M. E., Ernesto Méndez, V., Santos, R., Goldoftas, B. and Dougherty, I., 2014. Explaining the 'hungry farmer paradox': Smallholders and fair trade cooperatives navigate seasonality and change in Nicaragua's corn and coffee markets, *Global Environmental Change,* **25**(0): 133-149. Available at: http://dx.doi.org/10.1016/j.gloenvcha.2014.02.005

Bacon, C. M., Sundstrom, W. A., Stewart, I. T. and Beezer, D., 2017. Vulnerability to Cumulative Hazards: Coping with the Coffee Leaf Rust Outbreak, Drought, and Food Insecurity in

Nicaragua, *World Development,* **93**: 136-152. Available at: https://doi.org/10.1016/j.worlddev.2016.12.025

Bankoff, G., 2007. One island too many: reappraising the extent of deforestation in the Philippines prior to 1946, *Journal of Historical Geography,* **33**(2): 314-334. Available at: http://dx.doi.org/10.1016/j.jhg.2006.06.021

Barclay, K., Voyer, M., Mazur, N., Payne, A. M., Mauli, S., Kinch, J., Fabinyi, M. and Smith, G., 2017. The importance of qualitative social research for effective fisheries management, *Fisheries research,* **186**: 426-438.

Barling, D. and Duncan, J., 2015. The dynamics of the contemporary governance of the world's food supply and the challenges of policy redirection, *Food Security,* **7**(2): 415-424. Available at: 10.1007/s12571-015-0429-x

Barreteau, O., Bots, P. and Daniell, K. A., 2010. A Framework for Clarifying "Participation" in Participatory Research to Prevent its Rejection for the Wrong Reasons, *Ecology and society,* **15**(2): Available online: https://www.ecologyandsociety.org/vol15/iss12/art11/.

Bawden, R. J. and Packham, R. G., 1993. Systemic praxis in the education of the agricultural systems practitioner, *Systems practice,* **6**(1): 7-19. Available at: 10.1007/bf01059677

Baynes, J., Herbohn, J. and Dressler, W., 2016. Power relationships: Their effect on the governance of community forestry in the Philippines, *Land Use Policy,* **54**: 169-176. Available at: http://dx.doi.org/10.1016/j.landusepol.2016.01.008

Baynes, J., Herbohn, J. and Russell, I., 2011a. The Influence of Farmers' Mental Models on an Agroforestry Extension Program in the Philippines, *Small-scale forestry,* **10**(3): 377-387. Available at: 10.1007/s11842-010-9154-7

Baynes, J., Herbohn, J., Russell, I. and Smith, C., 2011b. Bringing Agroforestry Technology to Farmers in the Philippines: Identifying Constraints to the Success of Extension Activities Using Systems Modelling, *Small-scale forestry,* **10**(3): 357-376. Available at: 10.1007/s11842-010-9153-8

Bednarek, A. T., Wyborn, C., Cvitanovic, C., Meyer, R., Colvin, R. M., Addison, P. F. E., Close, S. L., Curran, K., Farooque, M., Goldman, E., Hart, D., Mannix, H., McGreavy, B., Parris, A., Posner, S., Robinson, C., Ryan, M. and Leith, P., 2018. Boundary spanning at the science–policy interface: the practitioners' perspectives, *Sustainability Science,* **13**(4): 1175-1183. Available at: 10.1007/s11625-018-0550-9

Bellotti, B., 2017. *A research agenda for food systems*, University of Queensland, Brisbane, Queensland.

Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F. and Khoury, C. K., 2019. When food systems meet sustainability – Current narratives and implications for actions, *World Development,* **113**: 116-130. Available at: https://doi.org/10.1016/j.worlddev.2018.08.011

Benham, C. F. and Daniell, K. A., 2016. Putting transdisciplinary research into practice: A participatory approach to understanding change in coastal social-ecological systems, *Ocean & Coastal Management,* **128**: 29-39. Available at: http://dx.doi.org/10.1016/j.ocecoaman.2016.04.005

Berbés-Blázquez, M., González, J. A. and Pascual, U., 2016. Towards an ecosystem services approach that addresses social power relations, *Current Opinion in Environmental Sustainability,* **19**: 134-143. Available at: http://dx.doi.org/10.1016/j.cosust.2016.02.003

Bernstein, H., 2014. Food sovereignty via the 'peasant way': a sceptical view, *The Journal of Peasant Studies*: 1-33. Available at: 10.1080/03066150.2013.852082 (accessed 2014/04/15).

Bernstein, H., 2016. Agrarian political economy and modern world capitalism: the contributions of food regime analysis, *The Journal of Peasant Studies,* **43**(3): 611-647. Available at: 10.1080/03066150.2015.1101456

Biermann, F., 2007. 'Earth system governance'as a crosscutting theme of global change research, *Global Environmental Change,* **17**(3-4): 326-337.

Blaikie, P. and Brookfield, H., 1987. *Land Degradation and Society*, Methuen, London.

Blay-Palmer, A., Knezevic, I. and Spring, A., 2014. Seeking common ground for food system transformation, *Dialogues in Human Geography,* **4**(2): 185-189. Available at: 10.1177/2043820614537154

Blay-Palmer, A., Sonnino, R. and Custot, J., 2015. A food politics of the possible? Growing sustainable food systems through networks of knowledge, *Agriculture and Human Values*: 1-17. Available at: 10.1007/s10460-015-9592-0

Blythe, J., Nash, K., Yates, J. and Cumming, G., 2017. Feedbacks as a bridging concept for advancing transdisciplinary sustainability research, *Current Opinion in Environmental Sustainability,* **26–27**: 114-119. Available at: https://doi.org/10.1016/j.cosust.2017.05.004

Blythe, J. L., 2015. Resilience and social thresholds in small-scale fishing communities, *Sustainability Science,* **10**(1): 157-165. Available at: 10.1007/s11625-014-0253-9

Borden, R., 2014. *Ecology and experience: Reflections from a Human Ecological Perspective*, North Atlantic Books,

Borden, R., 2017. A Century of Human Ecology: Recollections and Tributes— On the Occasion of the 100th Anniversary of the Ecological Society of America, *Human Ecology Review,* **23**(2): 3-6.

Borras Jr, S. M., Edelman, M. and Kay, C., 2008. Transnational Agrarian Movements: Origins and Politics, Campaigns and Impact, *Journal of Agrarian Change,* **8**(2-3): 169-204. Available at: 10.1111/j.1471-0366.2008.00167.x

Borras, S. M., 2006. Redistributive land reform in 'public' (forest) lands? Lessons from the Philippines and their implications for land reform theory and practice, *Progress in Development Studies,* **6**(2): 123-145. Available at: 10.1191/1464993406ps132oa

Borras, S. M., 2007. 'Free Market', Export-Led Development Strategy and Its Impact on Rural Livelihoods, Poverty and Inequality: The Philippine Experience Seen from a Southeast Asian Perspective, *Review of International Political Economy,* **14**(1): 143-175. Available at: http://www.jstor.org/stable/25261903

Borras, S. M. and Franco, J. C., 2005. Struggles for land and livelihood, *Critical Asian Studies,* **37**(3): 331-361. Available at: 10.1080/14672710500200383

Borras, S. M., Franco, J. C., Isakson, S. R., Levidow, L. and Vervest, P., 2015. The rise of flex crops and commodities: implications for research, *The Journal of Peasant Studies*: 1-23. Available at: 10.1080/03066150.2015.1036417

Boyden, S., 1992. Biohistory: The Interplay Between Human Society and the Biosphere, *Man and the Biosphere Series, CRES, Australian National University,* **8**: 95-105.

Boyden, S., 2001. Nature, Society, History and Social Change, *Innovation,* **14**(2): 103-116.

Boyden, S., 2004. *The Biology of Civilisation: Understanding Human Culture as a Force in Nature*, University of New South Wales Press, Sydney.

Boyden, S., 2016. The Biohistorical Paradigm: The Early Days of Human Ecology at The Australian National University, *Human Ecology Review,* **22**(2): 25-46.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D. J., Newig, J., Reinert, F., Abson, D. J. and von Wehrden, H., 2013. A review of transdisciplinary research in sustainability science, *Ecological Economics,* **92**: 1-15. Available at: http://dx.doi.org/10.1016/j.ecolecon.2013.04.008

Braun, V. and Clarke, V., 2008. Using thematic analysis in psychology, *Qualitative Research in Psychology,* **3**(2): 77-101.

Brem-Wilson, J., 2015. Towards food sovereignty: interrogating peasant voice in the United Nations Committee on World Food Security, *The Journal of Peasant Studies,* **42**(1): 73-95. Available at: 10.1080/03066150.2014.968143 (accessed 2015/04/12).

Briones Alonso, E., Cockx, L. and Swinnen, J., 2018. Culture and food security, *Global Food Security*. Available at: https://doi.org/10.1016/j.gfs.2018.02.002

Brooks, S., 2011. Is international agricultural research a global public good? The case of rice biofortification, *The Journal of Peasant Studies,* **38**(1): 67-80. Available at: 10.1080/03066150.2010.538581

Brown, V. A., Harris, J. A. and Russell, J. Y., 2010. *Tackling wicked problems through the transdisciplinary imagination*, Earthscan, London.

Bryant, R. L., 1992. Political ecology: An emerging research agenda in Third-World studies, *Political Geography,* **11**(1): 12-36. Available at: http://dx.doi.org/10.1016/0962-6298(92)90017-N

Bryant, R. L., 1998. Power, knowledge and political ecology in the third world: a review, *Progress in Physical Geography,* **22**(1): 79-94. Available at: 10.1177/030913339802200104

Burchi, F. and De Muro, P., 2016. From food availability to nutritional capabilities: Advancing food security analysis, *Food Policy,* **60**: 10-19. Available at: http://dx.doi.org/10.1016/j.foodpol.2015.03.008

Burnett, K., 2013. Trouble in the Fields: Fair Trade and Food Sovereignty Responses to Governance Opportunities After the Food Crisis, *Geopolitics*: 1-26. Available at: 10.1080/14650045.2012.752356 (accessed 2014/04/15).

Burnett, K. and Murphy, S., 2014. What place for international trade in food sovereignty?, *The Journal of Peasant Studies,* **41**(6): 1065-1084. Available at: 10.1080/03066150.2013.876995

Byres, T. J., 2009. The landlord class, peasant differentiation, class struggle and the transition to capitalism: England, France and Prussia compared, *The Journal of Peasant Studies,* **36**(1): 33-54. Available at: 10.1080/03066150902820453 (accessed 2015/01/12).

Campbell, B. M., Beare, D. J., Bennett, E. M., Hall-Spencer, J. M., Ingram, J. S. I., Jaramillo, F., Ortiz, R., Ramankutty, N., Sayer, J. A. and Shindell, D., 2017. Agriculture production as a major driver of the Earth system exceeding planetary boundaries, *Ecology and society,* **22**(4). Available at: 10.5751/ES-09595-220408

Candel, J., 2014. Food security governance: a systematic literature review, *Food Security,* **6**(4): 585-601. Available at: 10.1007/s12571-014-0364-2

Candel, J. J. L. and Pereira, L., 2017. Towards integrated food policy: Main challenges and steps ahead, *Environmental Science & Policy,* **73**: 89-92. Available at: https://doi.org/10.1016/j.envsci.2017.04.010

Caniglia, G., Schäpke, N., Lang, D. J., Abson, D. J., Luederitz, C., Wiek, A., Laubichler, M. D., Gralla, F. and von Wehrden, H., 2017. Experiments and evidence in sustainability science: A typology, *Journal of Cleaner Production,* **169**: 39-47.

Carlsson, L., Callaghan, E., Morley, A. and Broman, G., 2017. Food System Sustainability across Scales: A Proposed Local-To-Global Approach to Community Planning and Assessment, *Sustainability,* **9**(6): 1061. Available at: http://www.mdpi.com/2071-1050/9/6/1061

Carney, M., 2011a. "Food Security" and "Food Sovereignty": What frameworks are best suited fo social quity in food systems?, *Journal of Agriculture, Food Systems, and Community Development,* **2**(2): 71-87.

Carney, M., 2011b. The Food Sovereignty Prize: Implications for Discourse and Practice, *Food and Foodways,* **19**(3): 169-180. Available at: 10.1080/07409710.2011.599767 (accessed 2012/10/27).

Carolan, M., 2014. Getting to the core of food security and food sovereignty: Relationality with limits?, *Dialogues in Human Geography,* **4**(2): 218-220. Available at: 10.1177/2043820614537164

Carolan, M., 2016. *The Sociology of Food and Agriculture*, Routledge, New York.

Caron, P., Ferrero y de Loma-Osorio, G., Nabarro, D., Hainzelin, E., Guillou, M., Andersen, I., Arnold, T., Astralaga, M., Beukeboom, M., Bickersteth, S., Bwalya, M., Caballero, P., Campbell, B. M., Divine, N., Fan, S., Frick, M., Friis, A., Gallagher, M., Halkin, J.-P., Hanson, C., Lasbennes, F., Ribera, T., Rockstrom, J., Schuepbach, M., Steer, A., Tutwiler, A. and Verburg, G., 2018. Food systems for sustainable development: proposals for a profound four-part transformation, *Agronomy for Sustainable Development,* **38**(4): 41. Available at: 10.1007/s13593-018-0519-1

Carpenter, D., 2003. An investigation into the transition from technological to ecological rice farming among resource poor farmers from the Philippine island of Bohol, *Agriculture and Human Values,* **20**(2): 165-176. Available at: 10.1023/A:1024013509602

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jäger, J. and Mitchell, R. B., 2003. Knowledge systems for sustainable development, *Proceedings of the National Academy of Sciences of the United States of America,* **100**(14): 8086-8091. Available at: 10.1073/pnas.1231332100

Cedamon, E., Harrison, S., Herbohn, J. and Mangaoang, E., 2011. Compiling Market and Other Financial Data on Smallholder Forestry in Leyte, the Philippines, *Small-scale forestry,* **10**(2): 149-162. Available at: 10.1007/s11842-010-9115-1

Chaifetz, A. and Jagger, P., 2014. 40 Years of dialogue on food sovereignty: A review and a look ahead, *Global Food Security,* **3**(2): 85-91. Available at: http://dx.doi.org/10.1016/j.gfs.2014.04.002

Chaudhary, A. and Kastner, T., 2016. Land use biodiversity impacts embodied in international food trade, *Global Environmental Change,* **38**: 195-204. Available at: http://dx.doi.org/10.1016/j.gloenvcha.2016.03.013

Checkland, P. and Scholes, J., 1999. *Soft systems methodology: a 30-year retrospective*, John Wiley Chichester,

Christensen, C., 2015. Two Kinds of Economy, Two Kinds of Self - Toward More Managable, Hence More Sustainable and Just, Supply Chains, *Human Ecology Review,* **21**(2): 3-22.

Clapp, J., 2014a. Financialization, distance and global food politics, *Journal of Peasant Studies,* **41**(5): 797-814.

Clapp, J., 2014b. Food security and food sovereignty: Getting past the binary, *Dialogues in Human Geography,* **4**(2): 206-211.

Clapp, J., 2015. Distant agricultural landscapes, *Sustainability Science,* **10**(2): 305-316. Available at: 10.1007/s11625-014-0278-0

Clapp, J., 2017. The trade-ification of the food sustainability agenda, *The Journal of Peasant Studies,* **44**(2): 335-353. Available at: 10.1080/03066150.2016.1250077

Clapp, J. and Murphy, S., 2013. The G20 and Food Security: a mismatch in global governance? , *Global Policy,* **4**(2): 129-138.

Clapp, J., Newell, P. and Brent, Z. W., 2017. The global political economy of climate change, agriculture and food systems, *The Journal of Peasant Studies*: 1-9. Available at: 10.1080/03066150.2017.1381602

Clark, W. C., Tomich, T. P., van Noordwijk, M., Guston, D., Catacutan, D., Dickson, N. M. and McNie, E., 2011. Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR), *Proceedings of the National Academy of Sciences*. Available at: 10.1073/pnas.0900231108

Clark, W. C., van Kerkhoff, L., Lebel, L. and Gallopin, G. C., 2016. Crafting usable knowledge for sustainable development, *Proceedings of the National Academy of Sciences,* **113**(17): 4570-4578. Available at: 10.1073/pnas.1601266113

Cleland, D., Dray, A., Perez, P., Cruz-Trinidad, A. and Geronimo, R., 2012. Simulating the Dynamics of Subsistence Fishing Communities:REEFGAME as a Learning and Data-Gathering Computer-Assisted Role-Play Game, *Simulation & Gaming,* **43**(1): 102-117. Available at: 10.1177/1046878110380890

Cloke, J., 2013. Empires of Waste and the Food Security Meme, *Geography Compass,* **7**(9): 622-636. Available at: 10.1111/gec3.12068

Collins, A., 2017. Saying all the right things? Gendered discourse in climate-smart agriculture, *The Journal of Peasant Studies*: 1-17. Available at: 10.1080/03066150.2017.1377187

Colloff, M. J., Lavorel, S., Kerkhoff, L. E., Wyborn, C. A., Fazey, I., Gorddard, R., Mace, G. M., Foden, W. B., Dunlop, M. and Prentice, I. C., 2017. Transforming conservation science and practice for a postnormal world, *Conservation Biology,* **31**(5): 1008-1017. Available at: https://doi.org/10.1111/cobi.12912

Constance, D., 2019. 'Contested sustainability discourses in the agrifood system: an overview',in Constance, D., Konefal, J. and Hatanaka, M. (eds), *Contested sustainability discourses in the Agrifood system*, Routledge, Oxton, pp. 3-16.

Conway, G. R., 1985. Agroecosystem analysis, *Agricultural Administration,* **20**(1): 31-55. Available at: https://doi.org/10.1016/0309-586X(85)90064-0

Conway, G. R., 1987. The properties of agroecosystems, *Agricultural Systems,* **24**(2): 95-117. Available at: https://doi.org/10.1016/0308-521X(87)90056-4

Cooke, A., Curran, S. R., Linton, A. and Schrank, A., 2009. 'Agriculture, Trade and the Global Governance of Food',in Cooke, A., Curran, S. R., Linton, A. and Schrank, A. (eds), *The Global Governance of Food*, Routledge, New York.

Cororaton, C. B. and Corong, E., 2009. *Philippine Agriculture and Food Policies: Implications for Poverty and Income Distirbution*, International Food and Policy Research Institute,

Cramb, R., Manivong, V., Newby, J. C., Sothorn, K. and Sibat, P. S., 2016. Alternatives to land grabbing: exploring conditions for smallholder inclusion in agricultural commodity chains in Southeast Asia, *The Journal of Peasant Studies*: 1-29. Available at: 10.1080/03066150.2016.1242482

Creswell, J. W., 2007. *Designing and conducting mixed methods research.* , Sage Publications, Thousand Oaks, California

Crotty, M., 1998. *The foundations of social research: Meaning and perspective in the research process*, Sage,

Cuevas, S. M. M., Fernandez, J. E. C. and Olvida, I., 2015. Where Peasants Are Kings: Food Sovereignty in the Tagbanua Traditional Subsistence System *ASEAS - Austrian Journal of South-East Asian Studies,* **81**(1): 27-44.

Curato, N., 2017. *A Duterte Reader: Critical Essays on Rodrigo Duterte's Early Presidency*, Cornell University Press,

Dahlberg, K., 1979. Plenum Press, New York.

Daniel, R., Borines, L., Soguilon, C., Montiel, C., Palermo, V., Guadalquiver, G., Pedroso, M., Marcelino, R., Dionio, B., Juruena, M. and Guest, D., 2014. Development of disease management recommendations for the durian and jackfruit industries in the Philippines using farmer participatory research, *Food Security,* **6**(3): 411-422. Available at: 10.1007/s12571-014-0352-6

Davidson, J. S., 2016. Why the Philippines Chooses to Import Rice, *Critical Asian Studies,* **48**(1): 100-122. Available at: 10.1080/14672715.2015.1129184

Davila, F., 2018. Human ecology and food systems: Insights from the Philippines, *Human Ecology Review,* **24**(1): 23-50. Available at: http://doi.org/10.22459/HER.24.01.2018.02

Davila, F. and Dyball, R., 2015. Transforming Food Systems Through Food Sovereignty: An Australian Urban Context, *Australian Journal of Environmental Education,* **31**(Special Issue 01): 34-45. Available at: doi:10.1017/aee.2015.14 (accessed 2015).

Davila, F. and Dyball, R., 2018. 'Food Systems and Human Ecology: An Overview',in Koenig, A. (ed) *Sustainability Science: Key issues*, Routledge, London, pp. 183-210.

Davila, F., Dyball, R. and Amparo, J. M., 2018. Transdisciplinary research for food and nutrition security: Examining research-policy understandings in Southeast Asia, *Environmental Development,* **28**: 67-82. Available at: https://doi.org/10.1016/j.envdev.2018.10.001

de Leon, E. G. and Pittock, J., 2016. Integrating climate change adaptation and climate-related disaster risk-reduction policy in developing countries: A case study in the Philippines, *Climate and Development*: 1-8. Available at: 10.1080/17565529.2016.1174659

Dekeyser, K., Korsten, L. and Fioramonti, L., 2018. Food sovereignty: shifting debates on democratic food governance, *Food Security,* **10**(1): 223-233. Available at: 10.1007/s12571-017-0763-2

Delaney, A., Evans, T., McGreevy, J., Blekking, J., Schlachter, T., Korhonen-Kurki, K., Tamás, P. A., Crane, T. A., Eakin, H., Förch, W., Jones, L., Nelson, D. R., Oberlack, C., Purdon, M. and Rist, S., 2018. Governance of food systems across scales in times of social-ecological change: a review of indicators, *Food Security*. Available at: 10.1007/s12571-018-0770-y

Department of Science and Technology, 2013. *8th National Nutrition Survey 2013*, Manila, The Philippines. Available at: http://www.fnri.dost.gov.ph/images/sources/anthrop_children.pdf

Depositario, D. P., Custodio, H. and Burgos, B., 2015. *Meta-Analysis of SEARCA's Food Security Initiatives*, SEARCA., Available at: http://www.searca.org/index.php/research-and-development/rad-projects/1276-meta-analysis-of-searcas-food-security-initiatives- (accessed July 20 2016).

Depositario, D. P. and Saguiguit, G., 2014. *SEARCA Research Thrusts and Programmes through the years: The Way toward Food Security*, SEARCA,

Desker, B., Caballero-Anthony, M. and Teng, P., 2013. Thought/issues paper on ASEAN Food Security: Towards a more comprehensive framework, *ERIA Discussion Paper Series [ERIA-DP-2013-20]. Rajaratnam School of International Studies, Singapore*.

Desmarais, A. A., 2007. *La Via Campesina: Globalization and the power of Peasants*, Fernwood, Winnipeg.

Desmarais, A. A., 2008. The power of peasants: Reflections on the meanings of La Via Campesina, *Journal of Rural Studies,* **24**(2): 138-149.

Dethier, J.-J. and Effenberger, A., 2012. Agriculture and development: A brief review of the literature, *Economic Systems,* **36**(2): 175-205. Available at: 10.1016/j.ecosys.2011.09.003

Deutsch, L., Dyball, R. and Steffen, W., 2013. 'Feeding cities: food security and ecosystem support in an urbanizing world',in Elmqvist, T., Fragkias, M. and Goodness, J. (eds), *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities a Global Assessment*, Springer, Netherlands.

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., Larigauderie, A., Adhikari, J. R., Arico, S., Báldi, A., Bartuska, A., Baste, I. A., Bilgin, A., Brondizio, E., Chan, K. M. A., Figueroa, V. E., Duraiappah, A., Fischer, M., Hill, R., Koetz, T., Leadley, P., Lyver, P., Mace, G. M., Martin-Lopez, B., Okumura, M., Pacheco, D., Pascual, U., Pérez, E. S., Reyers, B., Roth, E., Saito, O., Scholes, R. J., Sharma, N., Tallis, H., Thaman, R., Watson, R., Yahara, T., Hamid, Z. A., Akosim, C., Al-Hafedh, Y., Allahverdiyev, R., Amankwah, E., Asah, S. T., Asfaw, Z., Bartus, G., Brooks, L. A., Caillaux, J., Dalle, G., Darnaedi, D., Driver, A., Erpul, G., Escobar-Eyzaguirre, P., Failler, P., Fouda, A. M. M., Fu, B., Gundimeda, H., Hashimoto, S., Homer, F., Lavorel, S., Lichtenstein, G., Mala, W. A., Mandivenyi, W., Matczak, P., Mbizvo, C., Mehrdadi, M., Metzger, J. P., Mikissa, J. B., Moller, H., Mooney, H. A., Mumby, P., Nagendra, H., Nesshover, C., Oteng-Yeboah, A. A., Pataki, G., Roué, M., Rubis, J., Schultz, M., Smith, P., Sumaila, R., Takeuchi, K., Thomas, S., Verma, M., Yeo-Chang, Y. and Zlatanova, D., 2015. The IPBES Conceptual Framework — connecting nature and people, *Current Opinion in Environmental Sustainability,* **14**: 1-16. Available at: https://doi.org/10.1016/j.cosust.2014.11.002

Dixon, J., 1999. A cultural economy model for studying food systems, *Agriculture and Human Values,* **16**(2): 151-160. Available at: 10.1023/a:1007531129846

Doss, C., Meinzen-Dick, R., Quisumbing, A. and Theis, S., 2017. Women in agriculture: Four myths, *Global Food Security*. Available at: https://doi.org/10.1016/j.gfs.2017.10.001

Dovers, S., 2001. *Institutions for Sustainability*, Economics and Environment Network, Australian National University., Canberra.

Dovers, S., 2005. *Environment and Sustainability Policy: Creation, Implementation and Evaluation*, The Federation Press, Sydney.

Dressler, W., 2005. Disentangling Tagbanua lifeways, swidden and conservation on Palawan Island, *Human Ecology Review,* **12**(1): 21-29.

Dressler, W., de Koning, J., Montefrio, M. and Firn, J., 2016a. Land sharing not sparing in the "green economy": The role of livelihood bricolage in conservation and development in the Philippines, *Geoforum,* **76**: 75-89. Available at: http://dx.doi.org/10.1016/j.geoforum.2016.09.003

Dressler, W. and Pulhin, J., 2010. The shifting ground of swidden agriculture on Palawan Island, the Philippines, *Agriculture and Human Values,* **27**(4): 445-459. Available at: http://dx.doi.org/10.1007/s10460-009-9239-0

Dressler, W. H., Wilson, D., Clendenning, J., Cramb, R., Keenan, R., Mahanty, S., Bruun, T. B., Mertz, O. and Lasco, R. D., 2016b. The impact of swidden decline on livelihoods and ecosystem services in Southeast Asia: A review of the evidence from 1990 to 2015, *Ambio*: 1-20. Available at: 10.1007/s13280-016-0836-z

Dryzek, J., 1997. *The Politics of the Earth: Environmental Discourses*, Oxford University Press, New York.

Dryzek, J., 2007. 'Paradigms and Discourses',in Bodansky, D., Brunnee, J. and Hey, E. (eds), *The Oxford Handbook of International Environmental Law* Oxford University Press, Oxford.

Dryzek, J. S., 2016. Institutions for the anthropocene: governance in a changing earth system, *British Journal of Political Science,* **46**(4): 937-956.

Dyball, R., 2010. 'Human Ecology and Open Transdisciplinary Inquiry',in Brown, V., Harris, J. A. and Russell, J. Y. (eds), *Tackling Wicked Problems: Through the Transdisciplinary Imagination* Earthscan, London.

Dyball, R., 2015. From industrial production to biosensitivity: the need for a food system paradigm shift, *Journal of Environmental Studies and Sciences*: 1-13. Available at: 10.1007/s13412-015-0323-z

Dyball, R., 2017. A brief history of Human Ecology within the Ecological Society of America and Speculation on Future Direction, *Human Ecology Review,* **23**(2): 7-15.

Dyball, R. and Newell, B., 2015. *Understanding human ecology: a systems approach to sustainability*, Routledge, London.

Edelman, M., 2014. The next stage of the food sovereignty debate, *Dialogues in Human Geography,* **4**(2): 182-184. Available at: 10.1177/2043820614537153

Ehrlich, P. R. and Harte, J., 2015. Food security requires a new revolution, *International Journal of Environmental Studies,* **72**(6): 908-920. Available at: 10.1080/00207233.2015.1067468

Ericksen, P., 2008a. Conceptualizing food systems for global environmental change research, *Global Environmental Change,* **18**(1): 234-245. Available at: https://doi.org/10.1016/j.gloenvcha.2007.09.002

Ericksen, P., 2008b. What Is the Vulnerability of a Food System to Global Environmental Change? , *Ecology and society,* **13**(2).

Ericksen, P. J., Stewart, B., Dixon, J., Barling, D., Loring, P., Anderson, M. and Ingram, J., 2010. 'The Value of a Food System Approach',in Ingram, J. S. I., Ericksen, P. J. and Liverman, D. M. (eds), *Food Security and Global Enviornmental Change* Earthscan, London.

ETC Group, 2009. *Who will feed us? Questions for the Food and Climate Crisis*, Available at: http://www.etcgroup.org/sites/www.etcgroup.org/files/ETC_Who_Will_Feed_Us.pdf (accessed August 20 2012).

ETC Group, 2017. *Who will feed us? The peasant food web vs. the Industrial food chain*, Available at: http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc-whowillfeedus-english-webshare.pdf_.pdf

Fairbairn, M., 2010. 'Framing Resistance: International Food Regimes & the Roots of Food Sovereignty',in Wittman, H., Desmarais, A. A. and Wiebe, K. (eds), *Food Sovereignty: Reconnecting Food, Nature and Community Fernwood*, Food First, Winnipeg, Canada, pp. 15-32.

Fan, S. and Brzeska, J., 2016. Sustainable food security and nutrition: Demystifying conventional beliefs, *Global Food Security*. Available at: http://dx.doi.org/10.1016/j.gfs.2016.03.005

Fanzo, J., 2014. Strengthening the engagement of food and health systems to improve nutrition security: Synthesis and overview of approaches to address malnutrition, *Global Food Security,* **3**(3): 183-192. Available at: https://doi.org/10.1016/j.gfs.2014.09.001

Fanzo, J., 2017. From big to small: the significance of smallholder farms in the global food system, *The Lancet Planetary Health,* **1**(1): e15-e16. Available at: 10.1016/S2542-5196(17)30011-6 (accessed 2018/07/02).

Fanzo, J., Hunter, D., Borelli, T. and Mattei, F., 2013. *Diversifying food and diets: using agricultural biodiversity to improve nutrition and health*, Routledge,

FAO, 2003. *Trade Reforms and Food Security: Conceptualizing the Linkages*, Rome: Commodity Policy and Projeciton Service, Commodities and Trade Division.,

FAO, 2017. *State of Food Insecurity 2017*, Food and Agriculture Organization, Available at: http://www.fao.org/3/a-I7695e.pdf

FAO, 2018. *State of Food Insecurity 2018*, Food and Agriculture Organization,

Farsund, A., Daugbjerg, C. and Langhelle, O., 2015. Food security and trade: reconciling discourses in the Food and Agriculture Organization and the World Trade Organization, *Food Security,* **7**(2): 383-391. Available at: 10.1007/s12571-015-0428-y

Ferguson, B. G., Bathfield, B., Díaz-Hernández, B., McCune, N. and Morales, H., 2012. Food security and global environmental change, *Journal of Peasant Studies,* **39**(1): 229-235.

Fischer, J., Abson, D. J., Bergsten, A., Collier, N. F., Dorresteijn, I., Hanspach, J., Hylander, K., Schultner, J. and Senbeta, F., 2017. Reframing the Food–Biodiversity Challenge, *Trends in Ecology & Evolution*.

Fischer, J., Dyball, R., Fazey, I., Gross, C., Dovers, S., Ehrlich, P. R., Brulle, R. J., Christensen, C. and Borden, R. J., 2012. Human behavior and sustainability, *Frontiers in Ecology and the Environment,* **10**(3): 153-160. Available at: https://doi.org/10.1890/110079

Fischer, J., Gardner, T. A., Bennett, E. M., Balvanera, P., Biggs, R., Carpenter, S., Daw, T., Folke, C., Hill, R., Hughes, T. P., Luthe, T., Maass, M., Meacham, M., Norström, A. V., Peterson, G., Queiroz, C., Seppelt, R., Spierenburg, M. and Tenhunen, J., 2015. Advancing sustainability through mainstreaming a social–ecological systems perspective, *Current Opinion in Environmental Sustainability,* **14**(0): 144-149. Available at: http://dx.doi.org/10.1016/j.cosust.2015.06.002

Flyvbjerg, B., 2001. *Making social science matter: why social science inquiry fails and how it can succeed again.*, Cambridge University Press, New York.

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N. and Snyder, P. K., 2005. Global Consequences of Land Use, *Science,* **309**(5734): 570. Available at: http://science.sciencemag.org/content/309/5734/570.abstract

Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., Mueller, N. D., O'Connell, C., Ray, D. K., West, P. C., Balzer, C., Bennett, E. M., Carpenter, S. R., Hill, J., Monfreda, C., Polasky, S., Rockström, J., Sheehan, J., Siebert, S., Tilman, D. and Zaks, D. P. M., 2013. Solutions for a cultivated planet, *Nature,* **501**(7468): S35-S40.

Folke, C., 2006. Resilience: The emergence of a perspective for social–ecological systems analyses, *Global Environmental Change,* **16**(3): 253-267. Available at: 10.1016/j.gloenvcha.2006.04.002

Foran, T., Butler, J. R. A., Williams, L. J., Wanjura, W. J., Hall, A., Carter, L. and Carberry, P. S., 2014. Taking Complexity in Food Systems Seriously: An Interdisciplinary Analysis, *World Development,* **61**(0): 85-101. Available at: http://dx.doi.org/10.1016/j.worlddev.2014.03.023

Forsyth, T., 2008. Political ecology and the epistemology of social justice, *Geoforum,* **39**: 756-764.

Francis, C. A., Lieblein, G., Breland, T. A., Salomonsson, L., Geber, U., Sriskandarajah, N. and Langer, V., 2008. Transdisciplinary Research for a Sustainable Agriculture and Food Sector, *Agronomy Journal,* **100**(3): 771-776. Available at: doi:10.2134/agronj2007.0073

Fraser, A., 2018. Land grab/data grab: precision agriculture and its new horizons, *The Journal of Peasant Studies*: 1-20. Available at: 10.1080/03066150.2017.1415887

Frei, M. and Becker, K., 2004. Agro-biodiversity in subsistence-oriented farming systems in a Philippine upland region: nutritional considerations, *Biodiversity and Conservation,* **13**(8): 1591-1610.

Friedmann, H. and McMichael, P., 1989. Agriculture and the State System: The Rise and Decline of National Agricultures, 1870 to the Present, *Socilogia Ruralis,* **29**(2).

Friel, S. and Ford, L., 2015. Systems, food security and human health, *Food Security,* **7**(2): 437-451. Available at: 10.1007/s12571-015-0433-1

Frison, E. A., Cherfas, J. and Hodgkin, T., 2011. Agricultural Biodiversity Is Essential for a Sustainable Improvement in Food and Nutrition Security, *Sustainability,* **3**(1): 238. Available at: http://www.mdpi.com/2071-1050/3/1/238

Fuglie, K., 2016. The growing role of the private sector in agricultural research and development world-wide, *Global Food Security,* **10**: 29-38. Available at: https://doi.org/10.1016/j.gfs.2016.07.005

Funtowicz, S. O. and Ravetz, J. R., 1991. 'A new scienti c methodology for global environmental issues',in Costanza, R. (ed) *Ecological economics:The science and management of sustainability.* , Columbia University Press, New York, pp. 137-152.

Funtowicz, S. O. and Ravetz, J. R., 1993. Science for the post-normal age, *Futures,* **25**(7): 739-755. Available at: http://dx.doi.org/10.1016/0016-3287(93)90022-L

Galt, R., 2016. The relevance of regional political ecology for agriculture and food systems, *Journal of Political Ecology,* **23**(115-203).

Galt, R. E., 2013. Placing Food Systems in First World Political Ecology: A Review and Research Agenda, *Geography Compass,* **7**(9): 637-658. Available at: 10.1111/gec3.12070

Garnett, T., 2016. Plating up solutions, *Science,* **353**(6305): 1202-1204. Available at: 10.1126/science.aah4765

Gliessman, S., 2007. *Agroecology: The ecology of sustainable food systems*, CRC Press, Boca Raton.

Gliessman, S. and Rosemeyer, M. (eds), 2010. *The Converstions to Sustainable Agriculture: Principles, Processes and Practices,* Taylor & Francis Group, Boca Raton, (original work

Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., Pretty, J., Robinson, S., Thomas, S. M. and Toulmin, C., 2010. Food security: the challenge of feeding 9 billion people, *Science,* **327**(5967): 812-818.

Goodman, D., 2001. Ontology Matters: The Relational Materiality of Nature and Agro-Food Studies, *Sociologia Ruralis,* **41**(2): 182-200. Available at: doi:10.1111/1467-9523.00177

Government of the Philippines, 1992. *Magna Carta of Small Farmers*, Available at: http://www.acpc.gov.ph/wp-content/uploads/2015/11/RA7606.pdf

Government of the Philippines, 2014. *An Act providing a framework for the right to adequte food. Senate Number 2137*, Available at: https://www.senate.gov.ph/lisdata/1877315901!.pdf

Grafton, R. Q., Daugbjerg, C. and Qureshi, M. E., 2015. Towards food security by 2050, *Food Security,* **7**(2): 179-183. Available at: 10.1007/s12571-015-0445-x

GRAIN, 2011. *Food and climate change: The Forgotten Link*, Available at: https://www.grain.org/media/W1siZiIsIjIwMTEvMDkvMjgvMDlfMzhfMTFfOTg3XzA5MjhfVjguQVRHX0NsaW1hdGVfRU4ucGRmIl1d

Groetschel, A., Aquino, R., Buchholz, I., Mazo, T., Ibkendanz, A., Sales, N., Seven, J., Vicentuan, K, 2001. *Natural Resource Management Strategies on Leyte Island, the Philippines*, Humboldt University, Berlin, Centre for Advanced Training in Rural Development.

Gustafson, D., Gutman, A., Leet, W., Drewnowski, A., Fanzo, J. and Ingram, J., 2016. Seven Food System Metrics of Sustainable Nutrition Security, *Sustainability,* **8**(3): 196. Available at: http://www.mdpi.com/2071-1050/8/3/196

Habito, C. and Briones, R., 2005. *Philippine agriculture over the years: Performance, policies and pitfalls. Paper presented at Policies to Strengthen Productivity in the Philippines, conference sponsored by the Asia-Europe Meeting (ASEM) Trust Fund*, Makati City, Philippines.

Haider, L. J., Hentati-Sundberg, J., Giusti, M., Goodness, J., Hamann, M., Masterson, V. A., Meacham, M., Merrie, A., Ospina, D., Schill, C. and Sinare, H., 2017. The undisciplinary journey: early-career perspectives in sustainability science, *Sustainability Science,* **13**(1): 191-204. Available at: 10.1007/s11625-017-0445-1

Hajer, M. and Versteeg, W., 2005. A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives, *Journal of Environmental Policy & Planning,* **7**(3): 175-184. Available at: 10.1080/15239080500339646 (accessed 2012/08/13).

Hall, D., 2015. 'The Political Ecology of International Agri-food Systems',in McCarthy, J., Bridge, G. and Perreault, T. A. (eds), *Routledge Hanbook of Political Ecology*, Routledge, Abingdon, Oxon.

Hammond, R. A. and Dubé, L., 2012. A systems science perspective and transdisciplinary models for food and nutrition security, *Proceedings of the National Academy of Sciences,* **109**(31): 12356-12363. Available at: 10.1073/pnas.0913003109

Hay, I. (ed) 2008. *Qualitative Research Methods in Human Geography,* Oxford University Press, Hong Kong, (original work

Herbohn, J. L., Vanclay, J., Ngyuen, H., Le, H., Baynes, J., Harrison, S. R., Cedamon, E., Smith, C., Firn, J. and Gregorio, N. O., 2014. Inventory procedures for smallholder and community woodlots in the Philippines: methods, initial findings and insights, *Small-scale forestry,* **13**(1): 79-100.

Herrero, M., Thornton, P. K., Power, B., Bogard, J. R., Remans, R., Fritz, S., Gerber, J. S., Nelson, G., See, L., Waha, K., Watson, R. A., West, P. C., Samberg, L. H., van de Steeg, J., Stephenson, E., van Wijk, M. and Havlík, P., 2017. Farming and the geography of nutrient production for human use: a transdisciplinary analysis, *The Lancet Planetary Health,* **1**(1): e33-e42. Available at: 10.1016/S2542-5196(17)30007-4 (accessed 2019/03/26).

Hickel, J., 2016. The true extent of global poverty and hunger: questioning the good news narrative of the Millennium Development Goals, *Third World Quarterly,* **37**(5): 749-767. Available at: 10.1080/01436597.2015.1109439

Hickel, J., 2017. The divide: A brief guide to global inequality and its solutions, *Cornerstone: William Heinemann*.

Hook, D., 2007. 'Discourse, knowledge, materiality, history: Foucault and discourse analysis',in *Foucault, Psychology and the Analytics of Power*, Springer, pp. 100-137.

Horgan, F. G., Ramal, A. F., Villegas, J. M., Almazan, M. L. P., Bernal, C. C., Jamoralin, A., Pasang, J. M., Orboc, G., Agreda, V. and Arroyo, C., 2016. Ecological engineering with high diversity vegetation patches enhances bird activity and ecosystem services in Philippine rice fields, *Regional Environmental Change*: 1-13. Available at: 10.1007/s10113-016-0984-5

Horlings, L. G. and Marsden, T. K., 2011. Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world', *Global Environmental Change,* **21**(2): 441-452. Available at: http://dx.doi.org/10.1016/j.gloenvcha.2011.01.004

Horton, P., 2017. We need radical change in how we produce and consume food, *Food Security*. Available at: 10.1007/s12571-017-0740-9

Horton, P., Banwart, S. A., Brockington, D., Brown, G. W., Bruce, R., Cameron, D., Holdsworth, M., Lenny Koh, S. C., Ton, J. and Jackson, P., 2017. An agenda for integrated system-wide

interdisciplinary agri-food research, *Food Security*: 1-16. Available at: 10.1007/s12571-017-0648-4

Hospes, O., 2013. Food sovereignty: the debate, the deadlock and suggested detour, *Agriculture and Human Values,* **31**(1): 119-130.

Hospes, O. and Brons, A., 2016. 'Food System Governance: A Systematic Literature Review ',in Kennedy, A. and Liljeblad, J. (eds), *Food Systems Governance: Challenges for justice, equality and human rights*, Routledge.

Ickowitz, A., Powell, B., Rowland, D., Jones, A. and Sunderland, T., 2019. Agricultural intensification, dietary diversity, and markets in the global food security narrative, *Global Food Security,* **20**.

IFPRI, 2015. *Global Nutrition Report: The Philippines*, IFPRI, Washington. Available at: http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/130014/filename/130225.pdf

Ingram, J., 2011a. A food systems approach to researching food security and its interactions with global environmental change, *Food Security,* **3**(4): 417-431. Available at: 10.1007/s12571-011-0149-9

Ingram, J., 2011b. 'From Food Production to Food Security: Developing interdisciplinary, regional-level research', Wageningen University, Wageningen University, The Netherlands.

Ingram, J., 2017. Perspective: Look beyond production, *Nature,* **544**(7651): S17-S17. Available at: 10.1038/544S17a

Ingram, J., Dyball, R., Howden, M., Vermeulen, S., Garnett, T., Redlingshofer, B., Guilbert, S. and Porter, J., 2016. Food Security, Food Systems, and Environmental Change, *Solutions,* **7**(3): 63-73.

Ingram, J., Ericksen, P. and Liverman, D., 2010. *Food security and global environmental change*, Earthscan, London.

Municipality of Inopacan, *Comprhensive Development Plan*,

IPCC, 2017. *Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SR2)*, Intergovernmental Panel on Climate Change, Working Group III - Mitigation of Climate Change,

IPES Food, 2015. *The New Science of Sustainable Food Systems: Overcoming Barriers to Food Systems Reform*, Available at: http://www.ipes-food.org/images/Reports/IPES_report01_1505_web_br_pages.pdf

IPES Food, 2017. Unravelling the Food–Health Nexus: Addressing practices, political economy, and power relations to build healthier food systems., *The Global Alliance for the Future of Food and IPES-Food*.

Isakson, S. R., 2009. No hay ganancia en la milpa: the agrarian question, food sovereignty, and the on-farm conservation of agrobiodiversity in the Guatemalan highlands, *The Journal of Peasant Studies,* **36**(4): 725-759. Available at: 10.1080/03066150903353876

Ison, R., 2018. Governing the human–environment relationship: systemic practice, *Current Opinion in Environmental Sustainability,* **33**: 114-123. Available at: https://doi.org/10.1016/j.cosust.2018.05.009

Ison, R. and Russell, D., 2000. *Agricultural Extension and Rural Development: breaking out of Traditions*, Cambridge University Press, Cambridge.

Ison, R. L., Maiteny, P. T. and Carr, S., 1997. Systems methodologies for sustainable natural resources research and development, *Agricultural Systems,* **55**(2): 257-272. Available at: https://doi.org/10.1016/S0308-521X(97)00010-3

Jansen, K., 2014. The debate on food sovereignty theory: agrarian capitalism, dispossession and agroecology, *The Journal of Peasant Studies*: 1-20. Available at: 10.1080/03066150.2014.945166 (accessed 2014/10/06).

Jarosz, L., 1996. Working in the global food system: a focus for international comparative analysis, *Progress in Human Geography,* **20**(1): 41-55. Available at: 10.1177/030913259602000103

Jarosz, L., 2014. Comparing food security and food sovereignty discourses, *Dialogues in Human Geography,* **4**(2): 168-181. Available at: 10.1177/2043820614537161

Kajikawa, Y., 2008. Research core and framework of sustainability science, *Sustainability Science,* **3**(2): 215-239. Available at: 10.1007/s11625-008-0053-1

Kalfagianni, A., 2015. 'Just food'. The normative obligations of private agrifood governance, *Global Environmental Change,* **31**(0): 174-186. Available at: http://dx.doi.org/10.1016/j.gloenvcha.2015.01.007

Kastner, T., 2009. Trajectories in human domination of ecosystems: Human appropriation of net primary production in the Philippines during the 20th century, *Ecological Economics,* **69**(2): 260-269. Available at: http://dx.doi.org/10.1016/j.ecolecon.2009.08.019

Kastner, T. and Nonhebel, S., 2010. Changes in land requirements for food in the Philippines: A historical analysis, *Land Use Policy,* **27**(3): 853-863. Available at: http://dx.doi.org/10.1016/j.landusepol.2009.11.004

Kauffman, J. and Arico, S., 2014. New directions in sustainability science: promoting integration and cooperation, *Sustainability Science,* **9**(4): 413-418. Available at: 10.1007/s11625-014-0259-3

Kelly, M., Banwell, C., Dixon, J., Seubsman, S.-a., Yiengprugsawan, V. and Sleigh, A., 2010. Nutrition transition, food retailing and health equity in Thailand, *Australasian epidemiologist / Australasian Epidemiological Association,* **17**(3): 4-7. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3307812/

Kerr, R. b., Hickey, C., Lupafya, E. and Dakishoni, L., 2019. Repairing rifts or reproducing inequalities? Agroecology, food sovereignty, and gender justice in Malawi AU - Bezner Kerr, Rachel, *The Journal of Peasant Studies*: 1-20. Available at: 10.1080/03066150.2018.1547897

Kneafsey, M., Dowler, E., Lambie-Mumford, H., Inman, A. and Collier, R., 2013. Consumers and food security: Uncertain or empowered?, *Journal of Rural Studies,* **29**(0): 101-112.

König, A. (ed) 2018. *Sustainability Science: Key Issues,* Routledge, London, (original work

Lakoff, G., 2004. *Don't think of an elephant: know your values and frame the debate*, Hartford: Chelsea Green Publishing, Vermont.

Lam, S., Dodd, W., Whynot, J. and Skinner, K., 2019. How is gender being addressed in the international development evaluation literature? A meta-evaluation, *Research Evaluation,* **28**(2): 158-168. Available at: 10.1093/reseval/rvy042 (accessed 4/3/2019).

Lang, D., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M. and Thomas, C., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges, *Sustainability Science,* **7**(1): 25-43. Available at: 10.1007/s11625-011-0149-x

Lang, D. J., Wiek, A. and von Wehrden, H., 2017. Bridging divides in sustainability science, *Sustainability Science,* **12**(6): 875-879. Available at: 10.1007/s11625-017-0497-2

Lang, T., 2010. Crisis? What Crisis? The Normality of the Current Food Crisis, *Journal of Agrarian Change,* **10**(1): 87-97. Available at: 10.1111/j.1471-0366.2009.00250.x

Lang, T. and Heasman, M., 2004. *Food Wars: The Global Battle for Mouths, Minds and Markets*, Earthscan, London.

Lasco, R. D., Delfino, R. J. P. and Espaldon, M. L. O., 2014. Agroforestry systems: helping smallholders adapt to climate risks while mitigating climate change, *Wiley Interdisciplinary Reviews: Climate Change,* **5**(6): 825-833. Available at: 10.1002/wcc.301

Lasco, R. D., Espaldon, M. L. O. and Habito, C. M. D., 2016. Smallholder farmers' perceptions of climate change and the roles of trees and agroforestry in climate risk adaptation: evidence from Bohol, Philippines, *Agroforestry Systems,* **90**(3): 521-540. Available at: 10.1007/s10457-015-9874-y

Lawrence, G., Lyons, K. and Walkington, T. (eds), 2010. *Food Security, Nutrition and Sustainability,* Earthscan, Oxon, (original work

Layder, D., 1998. *Sociological Practice: Linking Theory and Social Research*, Sage Publications, London.

Layder, D., 2013. *Doing Excellent Small-Scale Research*, SAGE, London.

Lee, R., 2007. Food security and food sovereignty, *Center for Rural Economy, University of Newcastle Upon Tyne, Discussion Paper Series,* (11).

Lee, R. P., 2012. The politics of international agri-food policy: discourses of trade-oriented food security and food sovereignty, *Environmental Politics*: 1-19. Available at: 10.1080/09644016.2012.730266 (accessed 2012/10/27).

Lee, R. P., 2013. The politics of international agri-food policy: discourses of trade-oriented food security and food sovereignty, *Environmental Politics,* **22**(2): 216-234. Available at: 10.1080/09644016.2012.730266

Leventon, J., Fleskens, L., Claringbould, H., Schwilch, G. and Hessel, R., 2016. An applied methodology for stakeholder identification in transdisciplinary research, *Sustainability Science*: 1-13. Available at: 10.1007/s11625-016-0385-1

Leventon, J. and Laudan, J., 2017. Local food sovereignty for global food security? Highlighting interplay challenges, *Geoforum,* **85**: 23-26. Available at: http://dx.doi.org/10.1016/j.geoforum.2017.07.002

Li, T. M., 2014. Can there be food sovereignty here?, *The Journal of Peasant Studies*: 1-7. Available at: 10.1080/03066150.2014.938058 (accessed 2014/10/06).

Lindgren, E., Harris, F., Dangour, A. D., Gasparatos, A., Hiramatsu, M., Javadi, F., Loken, B., Murakami, T., Scheelbeek, P. and Haines, A., 2018. Sustainable food systems—a health perspective, *Sustainability Science*. Available at: 10.1007/s11625-018-0586-x

Lockie, S., 2005. 'Interpreting the Australian-Philippines food trade in the context of debates on food security',in Fold, N. and Prittchard, B. (eds), *Cross-continental Food Chains*, Taylor and Francis Group, Great Britain.

Lockie, S., Tennent, R., Benares, C. and Carpenter, D., 2012. Is de-agrarianization inevitable? Subsistence, food security and market production in the uplands of Negros Occidental, the Philippines, *Int. J. Sociol. Agric. Food,* **19**(2): 214-228.

Loos, J., Abson, D. J., Chappell, M. J., Hanspach, J., Mikulcak, F., Tichit, M. and Fischer, J., 2014. Putting meaning back into "sustainable intensification", *Frontiers in Ecology and the Environment,* **12**(6): 356-361. Available at: 10.1890/130157 (accessed 2015/04/07).

Lövbrand, E., Beck, S., Chilvers, J., Forsyth, T., Hedrén, J., Hulme, M., Lidskog, R. and Vasileiadou, E., 2015. Who speaks for the future of Earth? How critical social science can extend the conversation on the Anthropocene, *Global Environmental Change,* **32**: 211-218. Available at: http://dx.doi.org/10.1016/j.gloenvcha.2015.03.012

Lowder, S. K., Skoet, J. and Raney, T., 2016. The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide, *World Development,* **87**: 16-29. Available at: http://dx.doi.org/10.1016/j.worlddev.2015.10.041

Lowitt, K., Hickey, G. M., Saint Ville, A., Raeburn, K., Thompson-Colón, T., Laszlo, S. and Phillip, L. E., 2015. Factors affecting the innovation potential of smallholder farmers in the Caribbean Community, *Regional Environmental Change,* **15**(7): 1367-1377.

Luedeling, E., Kindt, R., Huth, N. I. and Koenig, K., 2014. Agroforestry systems in a changing climate — challenges in projecting future performance, *Current Opinion in Environmental Sustainability,* **6**: 1-7. Available at: http://dx.doi.org/10.1016/j.cosust.2013.07.013

Lyons, K., 2014. Urban Food Advocates' tactics to rebuild food systems: Convergence and divergence in food security and food sovereignty discourses, *Dialogues in Human Geography,* **4**(2): 212-217. Available at: 10.1177/2043820614537163

Magliocca, N. R., Ellis, E. C., Allington, G. R. H., de Bremond, A., Dell'Angelo, J., Mertz, O., Messerli, P., Meyfroidt, P., Seppelt, R. and Verburg, P. H., 2018. Closing global knowledge gaps: Producing generalized knowledge from case studies of social-ecological systems, *Global Environmental Change,* **50**: 1-14. Available at: https://doi.org/10.1016/j.gloenvcha.2018.03.003

Maohong, B., 2012. Deforestation in the Philippines, 1946-1995 *Philippine Studies: Historical and Ethnographic Viewpoints,* **60**(1): 117-130.

Marin, A., Ely, A. and van Zwanenberg, P., 2016. Co-design with aligned and non-aligned knowledge partners: implications for research and coproduction of sustainable food systems, *Current Opinion in Environmental Sustainability,* **20**: 93-98. Available at: http://dx.doi.org/10.1016/j.cosust.2016.09.003

Marten, G. (ed) 1986. *Traditional Agriculture in Southeast Asia: A Human Ecology Perspective,* Westview Press, Boulder, Colorado, (original work

Martinez-Torres, M. E. and Rosset, P. M., 2010. La Via Campesina: the birth and evolution of a transnational social movement, *The Journal of Peasant Studies,* **37**(1): 149-175.

Mason, K. O. and Smith, H. L., 2003. Women's empowerment and social context: Results from five Asian countries, *Gender and Development Group, World Bank, Washington, DC*.

Maxwell, S., 1996. Food security: a post-modern perspective, *Food Policy,* **21**(2): 155-170. Available at: 10.1016/0306-9192(95)00074-7

Maye, D. and Kirwan, J., 2013. Food security: A fractured consensus, *Journal of Rural Studies,* **29**(0): 1-6. Available at: http://dx.doi.org/10.1016/j.jrurstud.2012.12.001

McCarthy, J. F. and Obidzinski, K., 2017. Framing the food poverty question: Policy choices and livelihood consequences in Indonesia, *Journal of Rural Studies,* **54**: 344-354. Available at: https://doi.org/10.1016/j.jrurstud.2017.06.004

McIntyre, B. D., Herren, H. R., Wakhungu, J. and Watson, R. T., 2009. International assessment of agricultural knowledge, science and technology for development (IAASTD): global report.

McMichael, P., 2006. Peasant prospects in the neoliberal age, *New Political Economy,* **11**(3): 407-418. Available at: 10.1080/13563460600841041 (accessed 2012/05/03).

McMichael, P., 2009a. A food regime genealogy, *The Journal of Peasant Studies,* **36**(1): 139-169.

McMichael, P., 2009b. 'Food Sovereignty, social reproduction and the agrarian question',in Akram-Lodhi, A. and Kay, C. (eds), *Peasants and Globalization: Political economy, rural transformation and the agrarian question*, Routledge, New York.

McMichael, P., 2014. Historicizing food sovereignty, *The Journal of Peasant Studies,* **41**(6): 933-957. Available at: 10.1080/03066150.2013.876999 (accessed 2015/01/12).

McMichael, P., 2016. Commentary: Food regime for thought, *The Journal of Peasant Studies,* **43**(3): 648-670. Available at: 10.1080/03066150.2016.1143816

McMichael, P. and Schneider, M., 2011. Food Security Politics and the Millennium Development Goals, *Third World Quarterly,* **32**(1): 119-139.

Meadows, D., 2008. *Thinking in Systems: A Primer*, Chelsea Green, White River Junction.

Midgley, G., 2000. *Systemic Intervention: Philosophy, Methodology and Practice*, Kluwer Academic/Plenum Publishers, New York.

Miller, C. A. and Wyborn, C., 2018. Co-production in global sustainability: Histories and theories, *Environmental Science & Policy,* (Online first). Available at: https://doi.org/10.1016/j.envsci.2018.01.016

Ministry of Health, 2012. *Lao PDR Lao Social Indicator Survey (LSIS) 2011-2012 (Multiple Indicator Cluster Survey / Demographic and Health Survey).* , Ministry of Health and Lao Statistics Bureau, Vientiane, Lao PDR. Available at: https://dhsprogram.com/pubs/pdf/FR268/FR268.pdf

Misra, M., 2017. Moving away from technocratic framing: agroecology and food sovereignty as possible alternatives to alleviate rural malnutrition in Bangladesh, *Agriculture and Human Values*: 1-15.

Misselhorn, A., Aggarwal, P., Ericksen, P., Gregory, P., Horn-Phathanothai, L., Ingram, J. and Wiebe, K., 2012. A vision for attaining food security, *Current Opinion in Environmental Sustainability,* **4**(1): 7-17. Available at: http://dx.doi.org/10.1016/j.cosust.2012.01.008

Mitchell, C., Cordell, D. and Fam, D., 2015. Beginning at the end: The outcome spaces framework to guide purposive transdisciplinary research, *Futures,* **65**: 86-96.

Montefrio, M. J. F., 2017. Land control dynamics and social-ecological transformations in upland Philippines, *The Journal of Peasant Studies*: 1-21. Available at: 10.1080/03066150.2016.1257988

Montefrio, M. J. F. and Dressler, W. H., 2016. The Green Economy and Constructions of the "Idle" and "Unproductive" Uplands in the Philippines, *World Development,* **79**(Supplement C): 114-126. Available at: https://doi.org/10.1016/j.worlddev.2015.11.009

Montesino Pouzols, F., Toivonen, T., Di Minin, E., Kukkala, A. S., Kullberg, P., Kuustera, J., Lehtomaki, J., Tenkanen, H., Verburg, P. H. and Moilanen, A., 2014. Global protected area expansion is compromised by projected land-use and parochialism, *Nature,* **516**(7531): 383-386. Available at: 10.1038/nature14032

http://www.nature.com/nature/journal/v516/n7531/abs/nature14032.html#supplementary-information

Moon, K. and Blackman, D., 2014. A Guide to Understanding Social Science Research for Natural Scientists, *Conservation Biology,* **28**(5): 1167-1177. Available at: 10.1111/cobi.12326

Moon, K., Brewer, T. D., Januchowski-Hartley, S. R., Adams, V. M. and Blackman, D. A., 2016. A guideline to improve qualitative social science publishing in ecology and conservation journals, *Ecology and society,* **21**(3). Available at: 10.5751/ES-08663-210317

Morton, J. F., 2007. The Impact of Climate Change on Smallholder and Subsistence Agriculture, *Proceedings of the National Academy of Sciences of the United States of America,* **104**(50): 19680-19685. Available at: http://www.jstor.org/stable/25450775

Msangi, S. and Rosegrant, M., 2009. *World agriculture in a dynamically-changing environment: IFRPI long-term outlook for food and agriculture under additional demand and constraints.*

Paper presented at the FAO expert meeting on how to feed the world in 2050, Available at: ftp://ftp.fao.org/docrep/fao/012/ak542e/ak542e05.pdf (accessed November 2015).

Mukul, S. A., Herbohn, J. and Firn, J., 2016. Tropical secondary forests regenerating after shifting cultivation in the Philippines uplands are important carbon sinks, *Scientific reports,* **6**: 22483.

Murphy, S., 2014. Expanding the possibilities for a future free of hunger, *Dialogues in Human Geography,* **4**(2): 225-228. Available at: 10.1177/2043820614537166

National Institute of Statistics, 2010. *Cambodia Demographic and Health SurveySA*, National Institute of Statistics (MOP) & Directorate General for Health (MOH), Phnom Penh, Cambodia.

National Statistical Office, 2012. *Multiple indicator cluster survey, Thailand*, National Statistical Office (NSO), United National Children's Fund (UNICEF), Ministry of Public Health (MOPH), National Health Security Office (NHSO), Thai Health Promotion Foundation (THPF), International Health Policy Program (IHPP), Available at: https://mics-surveys-prod.s3.amazonaws.com/MICS4/East%20Asia%20and%20the%20Pacific/Thailand/2012-2013/Final/Thailand%202012%20MICS_English.pdf

Navarrete, I. A., Tsutsuki, K. and Asio, V. B., 2013. Characteristics and fertility constraints of degraded soils in Leyte, Philippines, *Archives of Agronomy and Soil Science,* **59**(5): 625-639.

Newell, B., 2012. Simple models, powerful ideas: Towards effective integrative practice *Global Environmental Change,* **22**: 776-783. Available at: https://doi.org/10.1016/j.gloenvcha.2012.03.006

Newell, B. and Proust, K., 2018. 'Escaping the complexity dilemma',in Koenig, A. (ed) *Sustainability Science: Key Issues*, Routledge, Oxon, pp. 96-112.

Newell, B. and Siri, J., 2016. A role for low-order system dynamics models in urban health policy making, *Environment International,* **95**: 93-97. Available at: http://dx.doi.org/10.1016/j.envint.2016.08.003

Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., Mullany, E. C., Biryukov, S., Abbafati, C., Abera, S. F., Abraham, J. P., Abu-Rmeileh, N. M. E., Achoki, T., AlBuhairan, F. S., Alemu, Z. A., Alfonso, R., Ali, M. K., Ali, R., Guzman, N. A., Ammar, W., Anwari, P., Banerjee, A., Barquera, S., Basu, S., Bennett, D. A., Bhutta, Z., Blore, J., Cabral, N., Nonato, I. C., Chang, J.-C., Chowdhury, R., Courville, K. J., Criqui, M. H., Cundiff, D. K., Dabhadkar, K. C., Dandona, L., Davis, A., Dayama, A., Dharmaratne, S. D., Ding, E. L., Durrani, A. M., Esteghamati, A., Farzadfar, F., Fay, D. F. J., Feigin, V. L., Flaxman, A., Forouzanfar, M. H., Goto, A., Green, M. A., Gupta, R., Hafezi-Nejad, N., Hankey, G. J., Harewood, H. C., Havmoeller, R., Hay, S., Hernandez, L., Husseini, A., Idrisov, B. T., Ikeda, N., Islami, F., Jahangir, E., Jassal, S. K., Jee, S. H., Jeffreys, M., Jonas, J. B., Kabagambe, E. K., Khalifa, S. E. A. H., Kengne, A. P., Khader, Y. S., Khang, Y.-H., Kim, D., Kimokoti, R. W., Kinge, J. M., Kokubo, Y., Kosen, S., Kwan, G., Lai, T., Leinsalu, M., Li, Y., Liang, X., Liu, S., Logroscino, G., Lotufo, P. A., Lu, Y., Ma, J., Mainoo, N. K., Mensah, G. A., Merriman, T. R., Mokdad, A. H., Moschandreas, J., Naghavi, M., Naheed, A., Nand, D., Narayan, K. M. V., Nelson, E. L., Neuhouser, M. L., Nisar, M. I., Ohkubo, T., Oti, S. O., Pedroza, A*., et al.*, 2013. *Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013,*

Nguyen, H., Herbohn, J., Firn, J. and Lamb, D., 2012. Biodiversity–productivity relationships in small-scale mixed-species plantations using native species in Leyte province, Philippines, *Forest Ecology and Management,* **274**: 81-90. Available at: http://dx.doi.org/10.1016/j.foreco.2012.02.022

Nicholls, C., Altieri, M. and Vazquez, L., 2016. Agroecology: Principles for the Conversion and Redesign of Farming Systems, *Journal of Ecosystem & Ecography* **5**(10). Available at: 10.4172/2157-7625.S5-010

Nurhasan, M., Maehre, H. K., Malde, M. K., Stormo, S. K., Halwart, M., James, D. and Elvevoll, E. O., 2010. Nutritional composition of aquatic species in Laotian rice field ecosystems, *Journal of Food Composition and Analysis,* **23**(3): 205-213.

Nyéléni Declaration, 2007. *Declaration of the forum for food sovereignty*, Available at: https://nyeleni.org/DOWNLOADS/Nyelni_EN.pdf

Obersteiner, M., Stafford Smith, M., Hiepe, C., Brklacich and Rudder, W., 2010. 'Green Food Systems for 9 Billion',in Ingram, J. S. I., Ericksen, P. J. and Liverman, D. M. (eds), *Food Security and Global Environmental Change*, Earthscan, London.

Olabisi, L. S., 2011. Uncovering the Root Causes of Soil Erosion in the Philippines, *Society & Natural Resources,* **25**(1): 37-51. Available at: 10.1080/08941920.2011.563435 (accessed 2015/02/23).

Olsson, E., Kerselaers, E., Søderkvist Kristensen, L., Primdahl, J., Rogge, E. and Wästfelt, A., 2016. Peri-Urban Food Production and Its Relation to Urban Resilience, *Sustainability,* **8**(12): 1340.

Olsson, E. G. A., 2018. Urban food systems as vehicles for sustainability transitions, *Bulletin of Geography. Socio-economic Series,* **40**(40): 133-144.

Orr, S., Pittock, J., Chapagain, A. and Dumaresq, D., 2012. Dams on the Mekong River: Lost fish protein and the implications for land and water resources, *Global Environmental Change,* **22**(4): 925-932. Available at: https://doi.org/10.1016/j.gloenvcha.2012.06.002

Ostrom, E., 2009. A general framework for analysing sustainability of socio-ecological systems, *Science,* **325**: 1931.

Ostrom, E., 2010. 'Institutional analysis and development: Elements of the framework in historical perspective',in Crothers, C. (ed) *Historical developments and theoretical approaches in sociology*, Vol. 2, UNESCO-EOLSS, pp. 261-288.

Oya, C., 2009. The World Development Report 2008: inconsistencies, silences, and the myth of 'win-win' scenarios, *The Journal of Peasant Studies,* **36**(3): 593-601. Available at: 10.1080/03066150903142949 (accessed 2015/01/11).

Page, G. G., Wise, R. M., Lindenfeld, L., Moug, P., Hodgson, A., Wyborn, C. and Fazey, I., 2016. Co-designing transformation research: lessons learned from research on deliberate practices for transformation, *Current Opinion in Environmental Sustainability,* **20**: 86-92. Available at: http://dx.doi.org/10.1016/j.cosust.2016.09.001

Pardey, P. G., Chan-Kang, C., Dehmer, S. P. and Beddow, J. M., 2016. Agricultural R&D is on the Move, *Nature News,* **537**(7620): 301.

Parfitt, J., Barthel, M. and Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050, *Philosophical Transactions of the Royal Society B: Biological Sciences,* **365**(1554): 3065-3081. Available at: 10.1098/rstb.2010.0126

Pasa, A. E., 2011. Biodiversity study of a smallholder-protected forest ecosystem in Leyte, Philippines, *Biodiversity,* **12**(1): 38-45. Available at: 10.1080/14888386.2011.573702

Patel, R., 2009. Food Sovereignty, *Journal of Peasant Studies,* **36**(3): 663-706.

Patel, R., 2010. 'What does Food Sovereignty look like?',in Wittman, H., Desmarais, A. A. and Wiebe, N. (eds), *Food Sovereignty: Reconnecting Food, Nature and Community* Food First Oakland.

Peet, R., Robbins, P. and Watts, M., 2011. *Global Political Ecology*,

Pereira, L. and Drimie, S., 2016. Governance Arrangements for the Future Food System: Addressing Complexity in South Africa, *Environment: Science and Policy for Sustainable Development,* **58**(4): 18-31. Available at: 10.1080/00139157.2016.1186438

Pereira, L. and Ruysenaar, S., 2012. Moving from traditional government to new adaptive governance: the changing face of food security responses in South Africa, *Food Security,* **4**(1): 41-58. Available at: 10.1007/s12571-012-0164-5

Petersen, B. and Snapp, S., 2015. What is sustainable intensification? Views from experts, *Land Use Policy,* **46**: 1-10. Available at: http://dx.doi.org/10.1016/j.landusepol.2015.02.002

Philippine Statistic Authority, 2013. *Selected Food Security Indicators: Philippines 1990-2013*, Available at: http://philfsis.psa.gov.ph/index.php/id/18 (accessed February 2016).

Picchioni, F., Aurino, E., Aleksandrowicz, L., Bruce, M., Chesterman, S., Dominguez-Salas, P., Gersten, Z., Kalamatianou, S., Turner, C. and Yates, J., 2017. Roads to interdisciplinarity–working at the nexus among food systems, nutrition and health, *Food Security,* **9**(1): 181-189. Available at: http://dx.doi.org/10.1007/s12571-017-0658-2

Pinstrup-Andersen, P., 2003. 'Global food security: facts, myths, and policy needs.', *In IFA-FAO Agricultural Conference, 21, Rome, Italy. Available at: http://www.fertilizer.org/HomePage/LIBRARY/Conference-papers/Agriculture-Conferences/2003-IFA-Agriculture*, Conference, Location.

Pinstrup-Andersen, P., 2009. Food security: definition and measurement, *Food Security,* **1**(1): 5-7. Available at: 10.1007/s12571-008-0002-y

Pittock, J., Bjornlund, H., Stirzaker, R. and van Rooyen, A., 2017a. Communal irrigation systems in South-Eastern Africa: findings on productivity and profitability, *International Journal of Water Resources Development,* **33**(5): 839-847. Available at: 10.1080/07900627.2017.1324768

Pittock, J., Dumaresq, D. and Orr, S., 2017b. The Mekong River: trading off hydropower, fish, and food, *Regional Environmental Change*. Available at: 10.1007/s10113-017-1175-8

Polk, M., 2015. Transdisciplinary co-production: Designing and testing a transdisciplinary research framework for societal problem solving, *Futures,* **65**: 110-122.

Polk, M. and Bruckmeier, K., 2005. *The future of human ecology at the Gothenburg School*, Society for Human Ecology Conference Salt Lake City.

Porter, J. R., Dyball, R., Dumaresq, D., Deutsch, L. and Matsuda, H., 2014. Feeding capitals: Urban food security and self-provisioning in Canberra, Copenhagen and Tokyo, *Global Food Security,* **3**(1): 1-7. Available at: http://dx.doi.org/10.1016/j.gfs.2013.09.001

Posa, M. R. C., Diesmos, A. C., Sodhi, N. S. and Brooks, T. M., 2008. Hope for Threatened Tropical Biodiversity: Lessons from the Philippines, *Bioscience,* **58**(3): 231-240.

Powell, B., Thilsted, S., Ickowitz, A., Termote, C., Sunderland, T. and Herforth, A., 2015. Improving diets with wild and cultivated biodiversity from across the landscape, *Food Security,* **7**(3): 535-554. Available at: 10.1007/s12571-015-0466-5

PSA, 2009. *2006 and 2009 Municipal and City Level Poverty Estimates*, Philippines Statistics Authority, Makati City. Available at: https://psa.gov.ph/sites/default/files/2006%20and%202009%20SAE%20Report%20FINAL.PDF (accessed February 2018).

PSA, 2016. *Regional Profile: Eastern Visayas,* CountrySTAT Philippines. Available at: http://countrystat.psa.gov.ph/?cont=16&r=8.

PSA, 2017. *Selected Statistics on Agriculture*, Philippine Statistics Authority, Quezon City, Philippines.

Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A. and Peterman, A., 2014. *Gender in agriculture: closing the knowledge gap*, Springer Science & Business,

Rambo, T., 1983. *Conceptual Approaches to Human Ecology*, East-West Environment and Policy Institute,

Rambo, T. and Sajise, P. (eds), 1984. *An introduction to human ecology research on agricultural systems in Southeast Asia,* University of the Philippines and East-West Environment and Policy Institute, University of the Philippines Los Baños, Laguna, (original work

Rasul, G., 2016. Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia, *Environmental Development,* **18**: 14-25. Available at: http://dx.doi.org/10.1016/j.envdev.2015.12.001

Ravetz, J. R., 2006a. Post-normal science and the complexity of transitions towards sustainability, *Ecological Complexity,* **3**(4): 275-284. Available at: https://doi.org/10.1016/j.ecocom.2007.02.001

Ravetz, J. R., 2006b. Post-Normal Science and the complexity of transitions towards sustainability, *Ecological Complexity,* **3**: 275-284.

Reed, K., Collier, R., White, R., Wells, R., Ingram, J., Borelli, R., Haesler, B., Caraher, M., Lang, T., Arnall, A., Ajates Gonzalez, R., Pope, H., Blake, L. and Skykes, R., 2017. Training Future Actors in the Food System: A new collaborative cross-institutional, interdisciplinary training programme for students, *Exchanges: the Warwick Research Journal,* **4**(2): 201-218.

Reyes, C. M., Tabuga, A. D., Asis, R. D. and Datu, M. B. G., 2012. *Poverty and agriculture in the Philippines: Trends in income poverty and distribution*, PIDS Discussion Paper Series,

Ricciardi, V., Ramankutty, N., Mehrabi, Z., Jarvis, L. and Chookolingo, B., 2018. How much of the world's food do smallholders produce?, *Global Food Security,* **17**: 64-72. Available at: https://doi.org/10.1016/j.gfs.2018.05.002

Richards, L., 2014. *Handling qualitative data: A practical guide*, Sage,

Rivera-Ferre, M., 2012. Framing of Agri-food Research Affects the Analysis of Food Security: The Critical Role of the Social Sciences, *International Journal of Sociology of Agriculture and Food,* **19**(2): 162-175.

Rivera-Ferre, M. G., 2018. The resignification process of Agroecology: Competing narratives from governments, civil society and intergovernmental organizations, *Agroecology and Sustainable Food Systems,* **42**(6): 666-685. Available at: 10.1080/21683565.2018.1437498

Rivera-Ferre, M. G., Pereira, L., Karpouzoglou, T., Nicholas, K. A., Onzere, S., Waterlander, W., Mahomoodally, F., Vrieling, A., Babalola, F. D. and Ummenhofer, C. C., 2013. A vision for transdisciplinarity in future earth: Perspectives from young researchers, *Journal of Agriculture, Food Systems, and Community Development,* **3**(4): 249-260. Available at: https://doi.org/10.5304/jafscd.2013.034.031

Robbins, P., 2003. Political ecology in political geography, *Political Geography,* **22**(6): 641-645. Available at: http://dx.doi.org/10.1016/S0962-6298(03)00071-4

Robbins, P., 2012. *Political Ecology* Blackwell Publishing, Oxford UK.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin Iii, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. A., 2009. A safe operating space for humanity, *Nature,* **461**: 472. Available at: 10.1038/461472a

Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P., de Fraiture, C., Hatibu, N., Unver, O., Bird, J., Sibanda, L. and Smith, J., 2016. Sustainable intensification of agriculture for human prosperity and global sustainability, *Ambio*: 1-14. Available at: 10.1007/s13280-016-0793-6

Rodriguez, D. G. P., Rejesus, R. M. and Aragon, C. T., 2007. Impacts of an agricultural development program for poor coconut producers in the Philippines: An approach using panel data and propensity score matching techniques, *Journal of Agricultural and Resource Economics*: 534-557.

Roman-Alcalá, A., 2016. Conceptualising components, conditions and trajectories of food sovereignty's 'sovereignty', *Third World Quarterly*: 1-20. Available at: 10.1080/01436597.2016.1142366

Roux, D. J., Nel, J. L., Cundill, G., O'Farrell, P. and Fabricius, C., 2017. Transdisciplinary research for systemic change: who to learn with, what to learn about and how to learn, *Sustainability Science*. Available at: 10.1007/s11625-017-0446-0

Ryan, G. W. and Bernard, H. R., 2003. Techniques to identify themes, *Field methods,* **15**(1): 85-109.

Sahakian, M., Leuzinger, T. and Saloma, C., 2017. Uncovering changing prescriptions and practices around organic agriculture in Metro Manila, the Philippines, *Agroecology and Sustainable Food Systems,* **41**(5): 505-525. Available at: https://doi.org/10.1080/21683565.2017.1284173

Sajise, P., Rambo, T. and Rebancos, C. (eds), 1985. *Agroecosystem Research in Rural Resource Management and Development,* Southeast Asian Universities Agroecosystem Network, Laguna, Los Baños, (original work

Salas-Zapata, W., Rios-Osorio, L. and Trouchon-Osorio, A., 2013. Typology of scientific reflections needed for sustainability science development, *Sustainability Science,* **8**(4): 607-612. Available at: 10.1007/s11625-012-0183-3

Saldaña, J., 2015. *The coding manual for qualitative researchers*, Sage,

Sawin, B., Hamilton, H., Jone, A., Rice, P., Seville, R., Sweitzer, S. and Wright, D., 2003. *Commodity Systems Challenges: Moving Sustainability into the Mainstream of Natural Resource Economies*, Sustainability Institute, Hartland: Vermont.

Sayer, A., 2009. Who's Afraid of Critical Social Science?, *Current Sociology,* **57**(6): 767-786. Available at: 10.1177/0011392109342205

Schiavoni, C. M., 2016. The contested terrain of food sovereignty construction: toward a historical, relational and interactive approach, *The Journal of Peasant Studies*: 1-32. Available at: 10.1080/03066150.2016.1234455

SEARCA, 2014. *Pathways Toward Inclusive, Sustainable and Rural Development in Southeast Asia: Tenth Five-year Plan of SEAMEO SEARCA 2014-2019*, Available at: http://searca.org/phocadownload/brochures/pathways-to-isard.pdf (accessed May 2015).

Sen, A., 1981. *Poverty and famines: an essay on entitlement and deprivation*, Oxford university press,

Shattuck, A., Schiavoni, C. M. and VanGelder, Z., 2015. Translating the Politics of Food Sovereignty: Digging into Contradictions, Uncovering New Dimensions, *Globalizations,* **12**(4): 421-433. Available at: 10.1080/14747731.2015.1041243 (accessed 2015/09/20).

Shaw, J., 2007. *World Food Security: A History Since 1945*, Palgrave Macmillan, London.

Shaw, J., 2009. *Global Food and Agricultural Institutions*, Routledge, New York.

Sibhatu, K. T., Krishna, V. V. and Qaim, M., 2015. Production diversity and dietary diversity in smallholder farm households, *Proceedings of the National Academy of Sciences of the United States of America,* **112**(34): 10657-10662. Available at: 10.1073/pnas.1510982112

Slife, B. D., 2004. Taking practice seriously: Toward a relational ontology, *Journal of Theoretical and Philosophical Psychology,* **24**(2): 157.

Smith, A., Snapp, S., Chikowo, R., Thorne, P., Bekunda, M. and Glover, J., 2017a. Measuring sustainable intensification in smallholder agroecosystems: A review, *Global Food Security,* **12**: 127-138. Available at: http://dx.doi.org/10.1016/j.gfs.2016.11.002

Smith, L. C., El Obeid, A. E. and Jensen, H. H., 2000. The geography and causes of food insecurity in developing countries, *Agricultural Economics,* **22**(2): 199-215. Available at: https://doi.org/10.1111/j.1574-0862.2000.tb00018.x

Smith, L. C. and Haddad, L., 2015. Reducing Child Undernutrition: Past Drivers and Priorities for the Post-MDG Era, *World Development,* **68**: 180-204. Available at: https://doi.org/10.1016/j.worlddev.2014.11.014

Smith, M., Pointing, K. and Maxwell, S., 1992. *Household food security, concepts and definitions: an annotated bibliography*, Development Bibliography No 8, Institute of Development Studies, Brighton, University of Susex.

Smith, M. D., Rabbitt, M. P. and Coleman- Jensen, A., 2017b. Who are the World's Food Insecure? New Evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale, *World Development,* **93**: 402-412. Available at: http://dx.doi.org/10.1016/j.worlddev.2017.01.006

Sobal, J., Kettel Khan, L. and Bisogni, C., 1998. A conceptual model of the food and nutrition system, *Social Science & Medicine,* **47**(7): 853-863. Available at: http://dx.doi.org/10.1016/S0277-9536(98)00104-X

Soper, R., 2019. From protecting peasant livelihoods to essentializing peasant agriculture: problematic trends in food sovereignty discourse AU - Soper, Rachel, *The Journal of Peasant Studies*: 1-21. Available at: 10.1080/03066150.2018.1543274

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H. C. J., Tilman, D., Rockström, J. and Willett, W., 2018. Options for keeping the food system within environmental limits, *Nature*. Available at: 10.1038/s41586-018-0594-0

Stafford-Smith, M., Griggs, D., Gaffney, O., Ullah, F., Reyers, B., Kanie, N., Stigson, B., Shrivastava, P., Leach, M. and O'Connell, D., 2016. Integration: the key to implementing the Sustainable Development Goals, *Sustainability Science*: 1-9. Available at: 10.1007/s11625-016-0383-3

Steffan-Dewenter, I., Kessler, M., Barkmann, J., Bos, M. M., Buchori, D., Erasmi, S., Faust, H., Gerold, G., Glenk, K., Gradstein, S. R., Guhardja, E., Harteveld, M., Hertel, D., Höhn, P., Kappas, M., Köhler, S., Leuschner, C., Maertens, M., Marggraf, R., Migge-Kleian, S., Mogea, J., Pitopang, R., Schaefer, M., Schwarze, S., Sporn, S. G., Steingrebe, A., Tjitrosoedirdjo, S. S., Tjitrosoemito, S., Twele, A., Weber, R., Woltmann, L., Zeller, M. and Tscharntke, T., 2007. Tradeoffs between income, biodiversity, and ecosystem functioning during tropical rainforest conversion and agroforestry intensification, *Proceedings of the National Academy of Sciences,* **104**(12): 4973-4978. Available at: 10.1073/pnas.0608409104

Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., Crumley, C., Crutzen, P., Folke, C., Gordon, L., Molina, M., Ramanathan, V., Rockström, J., Scheffer, M., Schellnhuber, H. J. and Svedin, U., 2011. The Anthropocene: From Global Change to Planetary Stewardship, *Ambio,* **40**(7): 739-761. Available at: 10.1007/s13280-011-0185-x

Stevenson, H. and Dryzek, J. S., 2012. The discursive democratisation of global climate governance, *Environmental Politics,* **21**(2): 189-210. Available at: 10.1080/09644016.2012.651898

Stokols, D., 2018. *Social ecology in the Digital Age: Solving complex problems in a globalized world*, Academic Press,

Stone, G. D. and Glover, D., 2016. Disembedding grain: Golden Rice, the Green Revolution, and heirloom seeds in the Philippines, *Agriculture and Human Values*: 1-16. Available at: 10.1007/s10460-016-9696-1

Stuart, D. D., 2014. *Barnyards and Birkenstocks: Why Farmers and Environmentalists Need Each Other*, Washington State University Press,

Swinton, S. M., Lupi, F., Robertson, G. P. and Hamilton, S. K., 2007. Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits, *Ecological Economics,* **64**(2): 245-252. Available at: 10.1016/j.ecolecon.2007.09.020

Taylor, M., 2017. Climate-smart agriculture: what is it good for?, *The Journal of Peasant Studies*: 1-19. Available at: 10.1080/03066150.2017.1312355

Termeer, C. J. A. M., Drimie, S., Ingram, J., Pereira, L. and Whittingham, M. J., 2018. A diagnostic framework for food system governance arrangements: The case of South Africa, *NJAS - Wageningen Journal of Life Sciences,* **84**(Supplement C): 85-93. Available at: https://doi.org/10.1016/j.njas.2017.08.001

Thompson, J. and Scoones, I., 2009. Addressing the dynamics of agri-food systems: an emerging agenda for social science research, *Environmental Science and Policy,* **12**(4): 386-397. Available at: 10.1016/j.envsci.2009.03.001

Timmer, P., 2014. Food Security in Asia and the Pacific: The Rapidly Changing Role of Rice, *Asia & the Pacific Policy Studies,* **1**(1): 73-90. Available at: 10.1002/app5.6

Timmer, P., 2015. 'The Dynamics of Agricultural Development and Food Security in Southeast Asia: Historical Continuity and Rapid Change',in Coxhead, I. (ed) *Routledge Handbook of Southeast Asian Economics*, Routdledge.

Tomich, T. P., Brodt, S., Ferris, H., Galt, R., Horwath, W. R., Kebreab, E., Leveau, J. H., Liptzin, D., Lubell, M. and Merel, P., 2011. Agroecology: a review from a global-change perspective, *Annual Review of Environment and Resources,* **36**: 193-222.

Ulrich, W. and Reynolds, M., 2010. 'Critical systems heuristics',in *Systems approaches to managing change: A practical guide*, Springer, pp. 243-292.

UNDP, 2013. *2012/2013 Philippine Human Development Report*,

Van Der Ploeg, J. D., 2010. The Food Crisis, Industrialized Farming and the Imperial Regime, *Journal of Agrarian Change,* **10**(1): 98-106. Available at: 10.1111/j.1471-0366.2009.00251.x

van Kerkhoff, L., 2014. Developing integrative research for sustainability science through a complexity principles-based approach, *Sustainability Science,* **9**(2): 143-155. Available at: 10.1007/s11625-013-0203-y

van Kerkhoff, L. and Lebel, L., 2006. Linking Knowledge and Action for Sustainable Development, *Annual Review of Environment and Resources,* **31**(1): 445-477. Available at: doi:10.1146/annurev.energy.31.102405.170850

van Kerkhoff, L. E. and Lebel, L., 2015. Coproductive capacities: rethinking science-governance relations in a diverse world, **20**(1): 14. Available at: http://dx.doi.org/10.5751/ES-07188-200114

van Rooyen, A. F., Ramshaw, P., Moyo, M., Stirzaker, R. and Bjornlund, H., 2017. Theory and application of Agricultural Innovation Platforms for improved irrigation scheme management in Southern Africa, *International Journal of Water Resources Development,* **33**(5): 804-823. Available at: 10.1080/07900627.2017.1321530

Velten, S., Leventon, S., Jager, N. and Newig, J., 2015. What is sustainable Agriculture? A systematic review, *Sustainability,* **7**: 7833-7865.

VERBI Software, 2018. MAXQDA 2018, *computer program,* **VERBI Softwware, Berlin**.

Vermeulen, S. J., Campbell, B. and Ingram, J., 2012. Climate Change and Food Systems, *Annual Review of Environment and Resources,* **37**(1): 195-222. Available at: doi:10.1146/annurev-environ-020411-130608

Via Campesina, 1996. *Food Sovereignty: A Future Without Hunger*, Available at: http://viacampesina.org/downloads/pdf/policydocuments/POLICYDOCUMENTS-EN-FINAL.pdf. .

Wagner, A., Yap, D. L. T. and Yap, H. T., 2015. Drivers and consequences of land use patterns in a developing country rural community, *Agriculture, Ecosystems & Environment,* **214**: 78-85. Available at: http://dx.doi.org/10.1016/j.agee.2015.08.016

Wahlqvist, M., McKay, J., Chang, Y.-C. and Chiu, Y.-W., 2012. Rethinking the food security debate in Asia: some missing ecological and health dimensions and solutions, *Food Security,* **4**(4): 657-670. Available at: 10.1007/s12571-012-0211-2

Wald, N. and Hill, D. P., 2016. 'Rescaling' alternative food systems: from food security to food sovereignty, *Agriculture and Human Values,* **33**(1): 203-213. Available at: http://dx.doi.org/10.1007/s10460-015-9623-x

Walker, B. and Salt, D., 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*, Island Press, Washington DC.

Waterlander, W. E., Ni Mhurchu, C., Eyles, H., Vandevijvere, S., Cleghorn, C., Scarborough, P., Swinburn, B. and Seidell, J., 2018. Food Futures: Developing effective food systems interventions to improve public health nutrition, *Agricultural Systems,* **160**: 124-131. Available at: https://doi.org/10.1016/j.agsy.2017.01.006

Watson, G. W., Adalla, C. B., Shepard, B. M. and Carner, G. R., 2015. Aspidiotus rigidus Reyne (Hemiptera: Diaspididae): a devastating pest of coconut in the Philippines, *Agricultural and Forest Entomology,* **17**(1): 1-8. Available at: 10.1111/afe.12074

Westberg, L. and Polk, M., 2016. The role of learning in transdisciplinary research: Moving from a normative concept to an analytical tool through a practice-based approach, *Sustainability Science,* **11**(3): 385-397.

Westengen, O. T. and Banik, D., 2016. The State of Food Security: From Availability, Access and Rights to Food Systems Approaches, *Forum for Development Studies,* **43**(1): 113-134. Available at: 10.1080/08039410.2015.1134644

WHO, 2016. *The double burden of malnutrition,WHO,* Available at: www.who.int/nutrition/double-burden-malnutrition/en/

Wiek, A. and Iwaniec, D., 2014. Quality criteria for visions and visioning in sustainability science, *Sustainability Science,* **9**(4): 497-512. Available at: 10.1007/s11625-013-0208-6

Wiek, A. and Lang, D. J., 2016. 'Transformational sustainability research methodology',in Heinrichs, H., Martens, P., Michelsen, G. and Wiek, A. (eds), *Sustainability science: An introduction*, Springer, Dordrecht.

Wiek, A., Ness, B., Schweizer-Ries, P., Brand, F. S. and Farioli, F., 2012. From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects, *Sustainability Science,* **7**(1): 5-24. Available at: 10.1007/s11625-011-0148-y

Wilkinson, J., 2015. Food security and the global agrifood system: Ethical issues in historical and sociological perspective, *Global Food Security,* **7**: 9-14. Available at: http://dx.doi.org/10.1016/j.gfs.2015.12.001

Wilson, J., 2013. Model villages in the neoliberal era: the Millennium Development Goals and the colonization of everyday life, *The Journal of Peasant Studies,* **41**(1): 107-125. Available at: 10.1080/03066150.2013.821651 (accessed 2015/01/07).

Windfuhr, M. and Jonsen, J., 2005. *Food Sovereignty: Towards democracy in localized food systems*, ITDG Publishing, Warcickshire, UK.

Wittman, H., Chappell, M. J., Abson, D. J., Kerr, R. B., Blesh, J., Hanspach, J., Perfecto, I. and Fischer, J., 2016. A social–ecological perspective on harmonizing food security and biodiversity conservation, *Regional Environmental Change*: 1-11. Available at: 10.1007/s10113-016-1045-9

Wittman, H., Desmarais, A. A. and Wiebe, N., 2010. 'The Origins and Potential of Food Sovereignty',in Wittman, H., Annette Aurélie, D. and Wiebe, N. (eds), *Food Sovereignty: Reconnecting Food, Nature and Community* Fernwood, Winnipeg, Canada, pp. 1-12.

World Bank, 2008. *Global Development Report: Agriculture for Development*,

World Bank, 2010. *Poverty and equity databank: people living below the national poverty line*, Washington DC. Available at: http://databank.worldbank.org/data/reports.aspx?source=poverty-and-equity-database#

World Bank, 2012. *Poverty and equity databank: people living below the national poverty line*, Washington DC. Available at: http://databank.worldbank.org/data/reports.aspx?source=poverty-and-equity-database#

Wright, S., 2014. 'Food Sovereignty in Practice: A Study of Farmer-Led Sustainable Agriculture in the Philippines',in Andree, P., Ayres, J., Bosia, M. and Massicotte, M. J. (eds), *Globalization and Food Sovereignty: Global and Local Change in the New Politics of Food*, University of Toronto Press, Toronto.

Wyborn, C., 2015. Co-productive governance: A relational framework for adaptive governance, *Global Environmental Change,* (40): 56-67.

Yin, R. K., 2003. *Case study research: Design and methods*, Sage, Thousand Oaks.

Young, O., 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay and Scale.*, MIT Press, Massachusetts.

Zamora, O., de Guzman, L., Saguiguit, S., Talavera, M. T. and Gordoncillo, N., 2013. Leveraging agriculture to improve nutrition in the Philippines, *Food Security,* **5**(6): 873-886. Available at: 10.1007/s12571-013-0306-4

Zimmerman, K. and Bassett, T. (eds), 2003a. *Political Ecology: An Integrative Approach to Geography and Environment-Development Studies,* The Guildford Press, New York, (original work

Zimmerman, K. and Bassett, T., 2003b. *Political Ecology: An Integrative Approach to Geography and Environment-Development Studies*, The Guilford Press, New York.

Appendix 1: Ethics forms

Participant Information Sheet

Researcher:

I, Federico Davila, am conducting a Doctoral Research Project at the Fenner School of Environment and Society and the Australian National University.

Project Title: Researching the Relationships Between Food Security and Food Sovereignty in South-East Asia

General Outline of the Project:

Description and Methodology:

The objective of this project is to empirically explore how the food security global framework can intersect with food sovereignty in selected areas of South-East Asia to achieve sustainable socio-ecological outcomes. This exploration will be carried out using a qualitative research approach with key informants involved in the food security development sector in South-East Asia.

The method to be used to explore these issues will be semi-structured interviews with key informants in the field of international development and agriculture in South-East Asia. Key informants are experts in these field that hold in depth knowledge and understanding of the issues that cannot be obtain by other means.

Participants Profile:

The key informant groups will include development practitioners, national government institutions, research bodies, non-government organisations and farmer groups. Data is being collected from approximately 20 participants between November 10 and December 4, 2014 for Phase One off the project.

Use of Data and Feedback:

Qualitative data collected will be manually typed and stored in a secure digital file. The purpose of typing interviews is for subsequent qualitative analysis to be done using coding software.

Thematic analysis will be carried out, and findings will be used to write a Doctoral Thesis for the Australian National University. There is the possibility of publication of material that stems from the interviews.

Participant Involvement:

Think about this section from the point of view of the participant. What would you wish to know before deciding whether or not to participate in a research project?

Voluntary Participation & Withdrawal:

Participation in this project is voluntary and you may, without any penalty, decline to take part or withdraw from the research at any time until the work is prepared for publication without providing an explanation, or refuse to answer a question.

If you withdraw from this project at any time, data collected directly from you will be destroyed and note used for the project.

What will participants have to do?

As a participant, you will be asked open questions about your experience and knowledge associated with agricultural development, trade and international development assistance.

I will ask you if you are happy to be recorded in confidentiality so that thematic analysis can be conducted from the ideas presented by all participants.

We will have an open conversation about key issues regarding agricultural development, and you will be open to speak your mind about these issues.

Location and Duration:

The interview is expected to take between 30 to 60 minutes.

Interviews will be held between November 10 and December 4 2014.

The location of the interview will be at a place convenient to you were a private conversation can be carried out. An office, quiet restaurant or quiet outside area are suitable places for an interview.

Incentives:

No incentives are being offered.

Risks:

There are minimal risks associated with carrying out a semi-structured interview. If at any point any of the questions asked to not feel comfortable, please let me know. You can chose not to answer any question. If, after the interview, you feel uncomfortable with anything you said, please contact me and you can choose to withdraw anything you have said, or withdraw from the project.

There is a moderate risk of identifying organisations, such as multilateral banks or farmer organisations. However, your name will be kept confidential, and you can chose whether you wish to represent the organisation or speak freely as an individual.

Implications of Participation:

By participating in this project, you are contributing to further development of ideas on how food sovereignty and food security can work together to build sustainable food systems. As names will be kept confidential, there is likely to be no personal implications for you stemming from this project.

Confidentiality:

All names will be kept confidential as far as the law allows, so you will not be identified in the thesis writing or in any publication. Rather, all the ideas that emerge from the interviews will be analysed and themes will be discussed, without attributing names to anyone.

However, if you wish to openly discuss your organisation's role in the issues, we can discuss over the interview how to best manage confidentiality if you or your organisation wishes to be identified.

Data Storage:

Where:

Electronic data will be stored on a password-protected laptop computer and on a 1 terabyte hard drive. Both of these items will remain with the researcher as much as is feasibly possible in a field context. If any paper notes from the interviews exist, they will be stored in a locked bag with the research. Upon return to Australia, all notes and recordings will be stored in a locked cabinet at the ANU. All digital recordings will be deleted from the recording device once they have been saved securely

How long:

Data will be securely stored for at least five years from publication.

Destruction of Data:

After five years from publication, data will be securely deleted.

Queries and Concerns:

Contact Details for More Information:

If you would like any further details, please contact:

Federico Davila	Lorrae van Kerkhoff
Doctoral Researcher	Doctoral Panel Chair
Email: Federico.davila@anu.edu.au	Email: Lorrae.vankerkhoff@anu.edu.au
Mobile: +61 403 657 124	Phone: +61 2 6125 2748

Overseas Contacts (if relevant):

To be provided depending on the participant.

Contact Details if in Distress: If any of the questions that you are asking could be seen as stressful, you may like to include contact details to a counselling service. For example, if you are doing your research at the ANU, you could include contact details for the ANU Counselling service, or within Australia, for Lifeline.

Ethics Committee Clearance:

The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee. If you have any concerns or complaints about how this research has been conducted, please contact:

Ethics Manager
The ANU Human Research Ethics Committee
The Australian National University
Telephone: +61 2 6125 3427
Email: Human.Ethics.Officer@anu.edu.au

Participant Information Sheet – SEARCA Workshop June 22-23, 2015, Los Baños, Philippines

Researcher:

I, Federico Davila, am conducting a Doctoral Research Project at the Fenner School of Environment and Society and the Australian National University.

Project Title: Researching the Relationships Between Food Security and Food Sovereignty in South-East Asia

General Outline of the Project:

Description and Methodology:

The objective of this project is to empirically explore how the food security global framework can intersect with food sovereignty in selected areas of South-East Asia to achieve sustainable socio-ecological outcomes. This exploration will be carried out using a qualitative research approach with key informants involved in the food security development sector in South-East Asia.

One method is semi-structured interviews. This method does not apply to workshop participants.

The second method will be thematic analysis of workshop discussions facilitated by myself. Collaboration between SEARCA and the Australian National University led to a workshop on smallholder development being organised from June 22-23. The systems diagrams and discussions from this workshop will be used as a qualitative data set for this project.

Workshop Overview

The notes attached include the plan for the two day workshop. I will take notes and facilitate the workshop throughout the two days. If there are time constrains, there will need to be inevitable changes to the workshop. We will not add any material if this is the case. Rather, we will reduce the amount of material we cover to continue the workshop on schedule.

Participants Profile:

The participants in this workshop will be Philippine Government employees, researchers and industry representatives. All participants will be involved in some element of the agricultural sector in the Philippines.

Use of Data and Feedback:

If logistics allow, the workshop will be audio recorded and securely stored in a password protected laptop.

Qualitative data collected will be manually typed and stored in a secure digital file. The purpose of typing workshop discussions is for subsequent qualitative analysis to be done using coding software.

Thematic analysis will be carried out, and findings will be used to write a Doctoral Thesis for the Australian National University. There is the possibility of publication of material that stems from the themes identified from the workshops

Participant Involvement:

Voluntary Participation & Withdrawal:

Participation in this project is voluntary and you may, without any penalty, decline to take part or withdraw from the research at any time until the work is prepared for publication without providing an explanation, or refuse to answer a question.

If you withdraw from this project at any time, data collected directly from you will be destroyed and note used for the project.

What will participants have to do?

As a workshop participant, you will be asked to contribute to the discussions being facilitated. Participation is voluntary and you may choose to not speak if you do not wish to.

Location and Duration:

The workshop will take place at the SEARCA headquarters in Los Baños, Philippines, from June 22-23 2015.

Incentives:

No incentives are being offered.

Risks:

There are minimal risks associated with being part of this workshop. If at any point any of the questions asked to not feel comfortable, please let me know. You can chose not to answer any question. If, after the workshop, you feel uncomfortable with anything you said, please contact me and you can choose to withdraw anything you have said, or withdraw from the project.

Your name will be kept confidential, and you can chose whether you wish to represent the organisation or speak freely as an individual.

Implications of Participation:

By participating in this project, you are contributing to further development of ideas on how food sovereignty and food security can work together to build sustainable food systems. As names will be kept confidential, there is likely to be no personal implications for you stemming from this project.

Confidentiality:

All names will be kept confidential as far as the law allows, so you will not be identified in the thesis writing or in any publication. Rather, all the ideas that emerge from the workshop will be analysed and themes will be discussed, without attributing names to anyone.

However, if you wish to openly discuss your organisation's role in the issues, we can discuss at the end of the workshop how to best manage confidentiality if you or your organisation wishes to be identified.

Data Storage:

Where:

Electronic data will be stored on a password-protected laptop computer and on a 1 terabyte hard drive. Both of these items will remain with the researcher as much as is feasibly possible in a field context. If any paper notes from the workshop exist, they will be stored in a locked bag with the research. Upon return to Australia, all notes and recordings will be stored in a locked cabinet at the ANU. All digital recordings will be deleted from the recording device once they have been saved securely

How long:

Data will be securely stored for at least five years from publication.

Destruction of Data:

After five years from publication, data will be securely deleted.

Queries and Concerns:

Contact Details for More Information:

If you would like any further details, please contact:

Federico Davila	Lorrae van Kerkhoff
Doctoral Researcher	Doctoral Panel Chair
Email: Federico.davila@anu.edu.au	Email: Lorrae.vankerkhoff@anu.edu.au
Mobile: +61 403 657 124	Phone: +61 2 6125 2748

Overseas Contacts (if relevant):

To be provided depending on the participant.

Contact Details if in Distress: If any of the questions that you are asking could be seen as stressful, you may like to include contact details to a counselling service. For example, if you are doing your research at the ANU, you could include contact details for the ANU Counselling service, or within Australia, for Lifeline.

Ethics Committee Clearance:

The ethical aspects of this research have been approved by the ANU Human Research Ethics Committee. If you have any concerns or complaints about how this research has been conducted, please contact:

Ethics Manager
The ANU Human Research Ethics Committee
The Australian National University
Telephone: +61 2 6125 3427
Email: Human.Ethics.Officer@anu.edu.au

Transcript for Oral Consent

Researching the Relationships Between Food Security and Food Sovereignty in South-East Asia

Hello,

Thank you for taking the time to talk to me.

My name is **Federico Davila**, and I am conducting a Doctoral Research Project at the Fenner School of Environment and Society and the Australian National University.

I am the Principal Researcher for a project looking at how food security and food sovereignty interact in a development effectiveness context. The project is focusing on the agricultural development priorities of the South-East Asian Region.

The **objective** of this project is to empirically explore how the food security global framework can intersect with food sovereignty in selected areas of South-East Asia to achieve sustainable socio-ecological outcomes. This exploration will be carried out using a qualitative research approach with key informants involved in the food security development sector in South-East Asia.

I was wondering if it would be possible for me to ask you some questions regarding your involvement in agriculture in [this country].

All questions will be broad, and we will have a discussion about any issues you want to bring up.

Your involvement is fully voluntary, and you may withdraw from the interview or the project at any stage. I will give you a detailed information sheet with contact details if you wish to withdraw from the project.

You may chose to remain confidential when I write the findings of the project, however if you wish to name your organisation, please let me know.

Is this clear?

Do you have any questions about the project or the interview?

Are you happy for me to record this interview?

Thank you.

WRITTEN CONSENT for Participants

Researching the Relationships Between Food Security and Food Sovereignty in South-East Asia

The Information sheet for this project contains all the information you need to know. This information includes:

- Project objectives
- Data collection, storage and use
- Confidentiality information
- Contact details

Once you have read the information sheet, please read below and sign if you wish to participate in this research.

I have read and understood the Information sheet you have given me about the research project, and I have had any questions and concerns about the project addressed to my satisfaction. I agree to participate in the project.

Signature:…….

Do you agree for this interview to be taped on a digital audio recorder?

YES ☐ NO ☐ I agree to this interview being audio taped

I agree to be identified in the following way

YES ☐ NO ☐ Full name

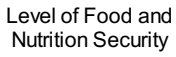
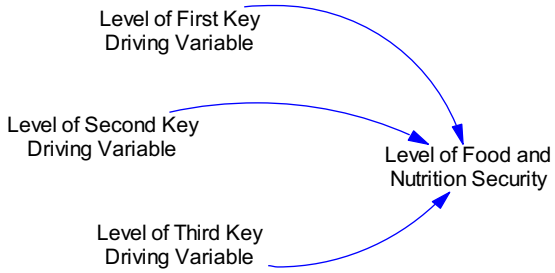
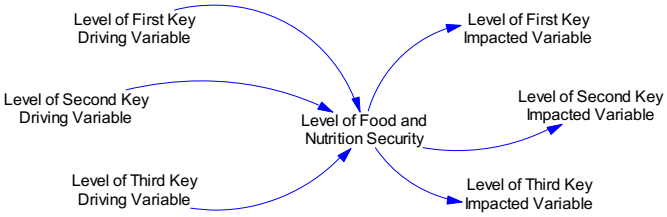
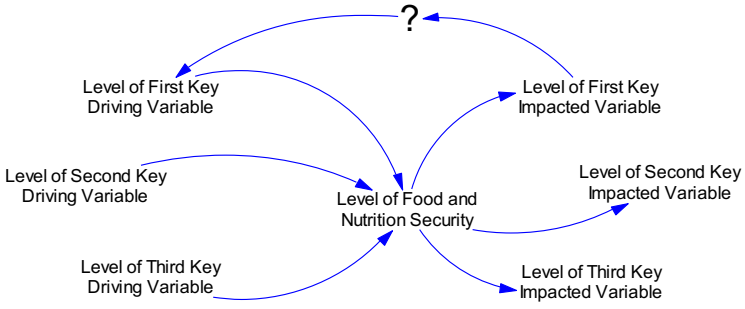
YES ☐ NO ☐ Pseudonym

YES ☐ NO ☐ Complete confidentiality

Signature:…….

Appendix 2: Supplementary Material for Chapter 5

Workshop facilitation guide

<table>
<tr><td colspan="2">Step One
In your groups, brainstorm the key factors that are influencing the levels of food and nutrition security for your selected food system of interest. Write these factors down in the form of ‘variables’ which can come in greater or lesser ‘amounts’. Pay attention to both physical variables, such as ‘Extent of Damage from Pests’, and non-physical variables, such as ‘Degree of Willingness to Trial New Farming Methods’. Spend about 10 minutes recording these variables.</td></tr>
<tr><td> 
</td><td>Step Two
Write the key focus variable of concern to ISARD ‘Level of Food and Nutrition Security’ in the middle of your sheet of paper.</td></tr>
<tr><td> 
</td><td>Step Three
Add those variables that your group thinks are the key variables driving changes in the levels of food and nutrition security (up or down).
Try to keep to a minimum number of the most important driving variables – ideally no more than 5.</td></tr>
<tr><td> 
</td><td>Step Four
Add those variables that your group thinks are most significantly impacted on by levels of food security.
Again, try to keep to a minimum number of those that are most important.</td></tr>
<tr><td> 
</td><td>Step Five
Can you see any cases where an ‘impacted variable’ influences a ‘driving variable’ (eg ‘amount of food surplus’ could influence ‘ability to invest in farm improvements’ via ‘level of income from sale of produce’). Add in any such loops.</td></tr>
<tr><td colspan="2">Step Six
Present your influence diagrams to the other workshop participants, discussing the feedback processes and variables selected.</td></tr>
</table>

Appendix 3: Semi-structured interview guide

Interview Protocol – Inopacan, Leyte

I am going to ask a series of open ended questions around five broad categories regarding food security as a development priority in the Philippines, and more broadly, South-East Asia. These categories will include:

- Overview of understanding
- Linkages between issues
- Implementation
- Challenges of programs
- Ideas for the future

Food security:

- What are the key priority areas for agriculture if for the next 10 years?
- What does food security mean to you?
- What are your priorities as a food producer? What influences your production?
- What support to you have for working towards your food security?

Sovereignty

- How much control do you have over your landscape?
- Do you feel you are able to influence your income and food security?
- Are there any barriers to production? Are these social, economic or environmental?
- How does external research or aid (if relevant in this area) influence your knowledge of production and your commodity value chain?

Rural development

- Are there any examples of successfully implemented rural development programs that have benefited food security?
- Have you notice changes in poverty reduction in this area? What do you think has led to some of these reductions?
- To what extent ware farmers from your community active in forums, decision making and extension services?

Changing behaviours

- What are the challenges you face regarding increasing production?
- How do you think you could benefit more from the value chain you are part of?
- What more can other sectors to do support your development ?

- Do you think there is sufficient support between government agencies for smallholder producers?

On power and policy understanding

- Do you think you have control of your land?
- Do you have visions for the future of your farm?
- Can you please explain the influence of the government on your farm and your relationship with government?

On knowledge

- What type of knowledge do you get given about production?
- What type of new skills and knowledge do you want to acquire?

On environmental conservation

- Over the years have you noticed environmental change?
- Do you actively pursue conservation, environmental protection?
- Have you seen any negative environmental effects on your products through time?
- Are there any opportunities to reduce environmental damage? Is this something you are interested in?

On food sovereignty and decision making

- Can you explain whether or not you think you can control what happens in your production system?
- Who or what constrains your ability to produce more or make more money?
- Are you concerned with changing production practices for more environmental conservation?
- Are you part of any farmer organisation? If so, what do these organisations provide you with?

Future Outlook

- How would you like rural development to pan out in the next 10 years
- What is your vision for your family?
- Do you think you can continue to produce in the current conditions? (environmentally, economically and socially)

Appendix 4: Coding structure from MAXQDA

Code
1 State of Human wellbeing
1.1 Diversity of Produce
1.2 Income
2 State of Institutions
2.1 Relationship with Government
2.2 Governance
2.3 Knowledge and Training
2.4 Smallholder agency
3 State of Discourses
3.1 Food sovereignty
3.1.1 Land Ownership
3.1.1.1 No ownership
3.1.1.2 Lack of power - land use
3.1.1.3 Land use decision making
3.1.2 Labour exchange
3.1.3 Food Sovereignty - control over land
3.2 Support desired
3.3 Food Security
3.3.1 Agricultural input
3.3.2 Production focus
3.3.3 Production problems
3.3.3.1 Production Issues
3.3.4 staple commodity production
3.3.5 Nutrition
3.3.5.1 Food security - production elsewhere
3.3.6 Food Security - Product Diversity
3.3.6.1 Diversification
3.3.7 Food Security - access to markets

- 3.3.8 Food Security - Self Consumption
- 3.4 Food Sec / Sovereignty Definition
- 4 State of ecosystems
- 4.1 Biodiversity & Environment conservation
- 4.2 Climate Change
- 4.2.1 Environmental Change
- 4.2.1.1 Impact of environment on their food security
- 4.2.1.1.1 Adaptation
- 5 Contextual
- 5.1 Failed Conservation Outcomes
- 5.1.1 Socio-political conditions affected by non-human actors
- 5.2 Power Relations
- 5.3 Enviro conflict caused by social structures
- 5.4 Peoples identity based on environmental conditions
- 5.5 Market dictates outcomes
- 5.6 Initiative
- 5.7 Gender
- 5.8 Risk Taking
- 5.9 Intercropping
- 5.10 Age influence
- 5.11 Health
- 5.12 Livelihood
- 5.13 Village relations
- 5.14 Loans
- 5.15 Future of farming in the Philippines
- 5.16 Organizations
- 5.17 Resource Conflict
- 5.18 Value Chain understanding
- 5.19 Clean the land metaphor
- 5.20 Participation
- 5.21 Barangay Captains

Appendix 5: Publications and professional activities during candidature

The following list incorporates all articles and reports published during candidature, including, but not limited to, those in the thesis.

* Indicates manuscripts in this thesis.

Academic Manuscripts

1. Moon, K. Blackman, D. Adams, V. Colvin, R. **Davila, F.** Evans, M. Januchowski-Hartley, S. Bennett, N. Dickinson, H. Sandbrook, C. Sherren, K. St John, F. van Kerkhoff, L. Wyborn, C. Accepted. Expanding the role of social science in conservation through an engagement with philosophy, methodology, and methods. *Methods in Ecology and Evolution.*
2. ***Davila, F.** Dyball, R. Amparo, J., 2018. Transdisciplinary reseatch for food and nutrition security: Examining research-policy understandings in Southeast Asia. *Environmental Development.* Online first.
3. ***Davila, F.** 2018. Human ecology and food systems: Insights from the Philippines. *Human Ecology Review*. 24(1): 23-50
4. ***Davila, F.** Dyball, R. 2018. Food systems and human Ecology: An Overview. In Konig, A (ed). 2018 Sustainability Science: Key Issues. Routledge, pp. 183-2010
5. Evans, M.C. **Davila, F.** Tommey, A. Wyborn, C. 2017. Embrace complexity to improve conservation in decision making. *Nature Ecology and Evolution.* 345:1
6. **Davila, F.** Reinhardt, W. 2017. Teaching as a Strategic Choice. In: McMaster, C. Murphy, C. Whitburn, B. Mewburn, I. Postgraduate Study in Australia: Surviving and succeeding. Peter Lang: New York.
7. **Davila, F.** 2015. Sustainable Food Systems: Building a New Paradigm. *Human Ecology Review*. 22(1), 167-171
8. Koenig, A. Dyball, R. **Davila, F**. 2016. Transforming the World by Transforming the University: Envisioning the University of 2040. *Solutions*. 7:3, p 12-16.
9. Smyth, L., **Davila, F**., Sloan, T., Rykers, E., Backwell, S. and Jones, S. (2016). How science really works: the student experience of research-led education. *Higher Education*. 27: 191-207
10. **Davila, F.** Dyball, R. (2015). Transforming Food Systems Through Food Sovereignty: An Australian Urban Context. *Australian journal of Environmental Education.* 2015, 31: 1, 34-45

Commissioned Reports

1. **Davila, F.** Sloan, T. Milne, M. van Kerkhoff, L. 2017. Impact Assessment of Giant Clam Investments in the Indo-Pacific. ACIAR Impact Assessment Series.

2. Amparo, J, **F Davila,** R Dyball, D.B Geges, C.E.G Jimena, C.T Malenab, E.T Mendoza, and S.L Saguiguit. 2017. An analysis of smallholder commodity systems using and integrative and systems based framework in two pilot ISARD sites in the Philippines. SEARCA SFRT Final Report., Los Baños, the Philippines.
3. **Davila, F.** Sloan, T. van Kerkhoff, L. 2016. Knowledge Systems and RAPID Framework for Impact Assessments. ACIAR Impact Assessment Series: 92. Available at: http://aciar.gov.au/publication/ias92

Conference Presentations

2018 – Australasian Aid Conference, Canberra, Australia

- Panel Organiser and presenter: Insights from Australia's experiences in agricultural research for development.

2017 – Society for Human Ecology International Conference, Los Baños, The Philippines

- Panel Organiser: Human Ecology in Practice – Reflections from Human Ecology Graduates
- Presentation: Human Ecology at the Australian National University
- Presentation: Food Systems and Human Ecology: Insights from smallholder farmer development in the Philippines

2017 – International Conference on Conservation Biology, Cartagena, Colombia

- Presentation: Reframing food research and policy to connect ecological and social outcomes in Southeast Asia

2017 – Australian Aid Conference, Canberra, Australia

- Presentation: Assessing the impact of Australian funded agricultural research on knowledge and policy

2015 – Acadia University, Nova Scotia, Canada

- Invited Expert: Workshop to develop a food systems metrics project proposal.

2015 – Leuphana University, Luneburg, Germany

- Presentation: Balancing Food Security and Sustainability in the Philippines.

2015 – Luc Hoffman Institute, WWF International, Gland, Switzerland

- Presentation: Balancing Food Security and Sustainability in the Philippines.

2014 – Asia Pacific Conference of Human Ecology, Manila, Philippines

- Paper presented: Food Sovereignty in the Philippines: What is it and what do we know?

2014 – International Alliance of Research Universities (IARU) Congress, Copenhagen, Denmark

- Poster presented: Food Sovereignty and Food Security Intersections
- Paper presented: Transforming food systems through food sovereignty: The Educative Value.